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## CONTENTS


| | PAGE |
|---|---|
| Inland Water Survey | 913 |
| Planning of Industry and Labour Supply | 915 |
| Principles of the Art of Electrical Communication | 916 |
| Science or Propaganda? By J. B. S. H. | 917 |
| The Human Outlook in Botany | 918 |
| Short Notices | 919 |
| Polarimetric Methods in Chemistry. By Prof. T. M. Lowry, C.B.E., F.R.S. | 920 |
| The Metamorphosis of Paper. By J. G. | 921 |
| Recent Aeronautical Research | 922 |
| Obituary: | |
| Prof. Willem de Sitter. By A. S. E. | 924 |
| The Rev. A. H. Cooke. By T. H. S. | 925 |
| News and Views | 926 |
| Letters to the Editor: | |
| A New Potato Epidemic in Great Britain.—Dr. Redcliffe N. Salaman and Cecilia O'Connor | 932 |
| Longevity of Seeds.—Sir Daniel Hall, K.C.B., F.R.S. | 932 |
| Kinetics of Photosynthesis.—Prof. E. C. C. Baly, C.B.E., F.R.S. | 933 |
| Inhibitors of Catalase Reaction.—Prof. D. Keilin, F.R.S., and E. F. Hartree | 933 |
| Passage of Very Fast Protons through Matter.—H. J. Bhabha | 934 |
| An Equation for the Kinetics of Activated Adsorption.—Prof. S. Roginsky | 935 |
| Absorption of Light in Gases.—Prof. R. W. Ditchburn and Dr. H. J. J. Braddick | 935 |
| Gyromagnetic Effect for a Ferromagnetic Substance above its Curie Point.—Dr. W. Sucksmith | 936 |
| Humidity-Resistance Relations in Carbon-Coated Hygroscopic Materials.—Dr. Lars A. Welo | 936 |
| The Maüle Reaction and the Systematic Position of the Gnetales.—Prof. R. C. McLean and Myfanwy Evans | 936 |
| Traffic Noise.—P. J. H. Unna | 937 |
| Corrections to the Refractive Indices of Quartz in the Infra-Red.—Dr. D. G. Drummond | 937 |
| Spectrum of Acrolein.—Dr. H. W. Thompson and J. W. Linnett | 937 |
| Research Items | 939 |
| The British Institute of Radiology | 942 |
| Centenary of the University of Brussels | 943 |
| Archæological Investigations in Shetland | 943 |
| Technical Aspects of Emulsions | 944 |
| University and Educational Intelligence | 945 |
| Science News a Century Ago | 945 |
| Societies and Academies | 946 |
| Forthcoming Events | 948 |
| Official Publications Received | 948 |


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## Inland Water Survey

THE announcement made in the House of Commons on December 7 by the Minister of Health that he had "decided that a comprehensive inland water survey shall be undertaken for Great Britain" will undoubtedly be received with a feeling of widespread satisfaction. It marks the successful culmination of a movement which has been constantly supported and earnestly advocated by NATURE, with, as we confidently believe, the sympathetic interest of our readers, especially those who are in any way concerned with the technical use and exploitation of water. The solitary position of Great Britain, alone among the more important nations of the world in failing to keep a systematic and reliable record of its water resources, has long been a reproach to its administrators and a source of regret and inconvenience in scientific and engineering circles. It is welcome news that the defect is to be remedied. The statement of the Minister of Health goes on to explain that "a water survey committee, composed of persons outside Government Departments, will be appointed to advise on the survey and on the progress of the measures undertaken". The precise constitution of this committee remains to be seen, as also the scope of the proposed operations; but on these points there may be occasion for comment later.

There is one feature, however, of the ministerial statement which, it must be avowed, produces a sense of disappointment. Reading the verbatim report of Sir Hilton Young's speech in the House of Commons, as also the supplementary remarks which he made the same day to the Institution of Water Engineers, any member of the general public, unacquainted with the inner history of the movement, might certainly conclude that the Ministry of Health is moving in the matter quite spontaneously and on its own initiative.

The inception of the proposal for a national survey can, however, be traced back a century, when the eminent engineer, Telford, was commissioned to report on the "Means of Supplying the Metropolis with Pure Water" and put forward a suggestion of this nature. In the subsequent period down to the present day, the recommendation was reiterated on numerous occasions in the proceedings of scientific and technical societies and in reports presented by successive departmental commissions of inquiry. These various reports were duly 'received', filed—and forgotten.

The matter developed with relative rapidity to its present stage quite definitely within the last eight or ten years, through the agency of a small private organisation, known as River Flow Records, promoted by Capt. W. N. McClean, who undertook gauging operations in certain river basins in Scotland with the object of giving practical demonstration of the way in which gauging records of the principal water areas in Great Britain might be kept. At the meeting of the British Association at York in September 1932, he introduced a discussion on the subject with a memorandum in which he directed attention to the essential value and fundamental importance of reliable records of water measurement in all problems connected not only with supplies of water for domestic consumption, but also for purposes of industry and commerce, power, navigation, irrigation, drainage and many other matters of public service. In the discussion which followed, the speakers were unanimous in affirming their conviction of the necessity for a national survey. Accordingly, on the joint recommendation of Sections A, E and G (Mathematical and Physical Sciences, Geography and Engineering), the General Committee of the Association approved the appointment of a research committee with instructions "to inquire into the position of Inland Water Survey in the British Isles and the possible organisation and control of such a survey by central authority". The Committee at its first meeting elected Vice-Admiral Sir Percy Douglas as chairman, Lieut.-Col. E. Gold as vice-chairman and Capt. W. N. McClean as hon. secretary. It also co-opted, with official cognizance and approval, representatives of the various Government Departments interested.

The Committee then made a careful and painstaking investigation extending over many months into all the available sources of information, and the following year it was in a position to present its first report (a lengthy document of 69 pages with numerous appendices containing detailed information) to the meeting of the Association at Leicester. This report was summarised in the issue of NATURE of November 11, 1933: its main conclusions were: (1) that a systematic survey of the water resources of Great Britain is urgently required; and (2) that the survey, in order to be of maximum utility, should be conducted by a central organisation, preferably under a Government department, independent of any interest in the administration, control or use of water.

At this stage, having regard (on account of the economic conditions prevailing at the time) to the impracticability of obtaining a grant from the public funds for the purpose of instituting the proposed survey, it was decided to invite the co-operation of the Institution of Civil Engineers, the Council of which body had offered to appoint a committee to investigate the feasibility of carrying out the objects outlined in the report on a self-supporting basis. Unfortunately, from lack of the necessary financial support, this scheme was found to be impracticable of realisation. It was then decided by a joint committee of the British Association and the Institution that the time had arrived when an appeal should be made to the Government on grounds of national utility and importance, exemplified by the situation arising out of the recent drought. The Prime Minister was approached through a memorandum signed by the respective presidents of the Association and the Institution, asking that he would be good enough to receive a deputation on the matter. As Mr. MacDonald was then on the point of leaving for Canada, the deputation was received in his stead by Sir Hilton Young on July 17 last. Having listened to the representations put forward, the Minister of Health promised that they should receive the most careful consideration of the Government.

No action or decision had, however, been announced from Whitehall at the time of the Aberdeen meeting of the British Association in September, when there was a full discussion of the subject and four Sections of the Association (this time including Geology) passed a joint resolution expressing the hope that the Government would decide upon "the establishment of an organised survey of the water resources of the country on a scientific basis". Now after two years of sustained investigation and advocacy by its promoters the fiat has gone forth that the survey is to be undertaken.

The foregoing account sets the present development in its proper sequence and enables the matter to be viewed in the right perspective. We have no wish to undervalue the care and attention which has been given to the proposal by the Ministry of Health and other Departments, but we have every reason for attributing the successful issue of the movement to the untiring efforts of its advocates. It is to the British Association and the Institution of Civil Engineers that credit must be given for the realisation of the demand for a national water survey.

## Planning of Industry and Labour Supply

THE reports of the investigations into the industrial conditions in certain economically depressed areas of the north of England, South Wales and Scotland* afford an impressive piece of evidence of the necessity for industrial planning on national lines if untoward social consequences are to be avoided. The picture of Durham and Tyneside, where whole areas have been drained of vitality, with the production of an attitude of resignation and of an incapacity to return to work when opportunity offers, through sheer lack of confidence and vitality, is appalling. Even this, and the urgent necessity of arresting the present decline, cannot overshadow Mr. J. C. C. Davidson's significant remarks on the need for a continuous survey of the problems of the depressed areas, and his endorsement of the recommendations of surveys recently made by the University of Liverpool that the State should devote greater resources to continuous intensive regional research, and play a greater part in regulating the initial location of new industries or businesses. His further conclusion that the worst problems in West Cumberland cannot be treated in isolation, but that the district must be treated as a whole, is in keeping with the conclusions reached by Sir Arthur Rose for Scotland and Sir Wyndham Portal for South Wales. All four commissioners, in fact, are at pains to emphasise the necessity for a national policy in regard to industrial transference and the development of new industries.

The report on West Cumberland indicates that this area is likely to have, for years to come, a substantial surplus of labour with no hope of outlet locally. There is little prospect of attracting new manufacturing industries, but on the other hand agriculture appears to offer greater possibilities than in the other areas, and afforestation also offers scope for development.

The need for a national policy is brought out very clearly by Capt. D. Euan Wallace in his report on Durham and Tyneside. He urges that steps be taken towards the national planning of industry, and recommends the unification of coal-mining royalties, the formation of an Industrial Development Company for Tyneside and a land settlement scheme financed by the Exchequer, as well as the clearance of derelict sites. Similarly, Sir Wyndham Portal directs attention to the danger of the situation in South Wales, which is practically dependent on the coal trade alone, being repeated in other parts of the country which rely on a single industry. If the economic planning of factories is not accompanied by the economic planning of labour supply, distressed areas may spring up in other places; planning of industry involves the simultaneous planning of labour supply. Already dangerous tendencies exist in the starting of steel and tinplate industries in Lincolnshire. The chief hope of industrial development in South Wales appears to be in the adoption of more scientific methods of utilising coal, and special reference is made to the possibility of the hydrogenation of coal being undertaken in South Wales. Pembroke, moreover, has outstanding claims for Government controlled works, and special stress is laid on the recommendation that some such factory should be located in the South Wales area.

The report on Scotland indicates that the problem there is not strictly one of derelict areas. There is evidence of definite surpluses of labour in the shalefields, North Ayrshire and Lanarkshire. The conditions in the whole area are mainly due to world conditions, and the removal of hindrances to international trade would go far to remedy matters. The tendency for industry to move south has deprived Scotland of the advantages of the new industrial developments, and it is considered that a designed direction of Government orders in rather larger proportions to the Clyde area would alleviate in a remarkably wide degree, and out of proportion to what it would do in other areas, the widespread and severe conditions of depression.

All of the commissioners allude to the growing volume of juvenile unemployment through the increasing number of 'school-leavers', and emphasise the importance of strenuous efforts at transfer. None of the reports, however, discusses the absorption capacity of other districts for this surplus, and Capt. Wallace is alone in referring to the effect on juvenile unemployment of raising the school leaving age, in spite of the close relation of this step to that of juvenile unemployment in Great Britain as a whole. The reports are thus silent on one of the most critical and serious problems of the whole country—the prevention of the development of a hard core of juvenile unemployables, who have never known regular occupation, or at most, known it only for a year or two before displacement by fresh school-leavers.

* Ministry of Labour. Reports of Investigations into the Industrial Conditions in Certain Depressed Areas of (1) West Cumberland and Haltwhistle, (2) Durham and Tyneside, (3) South Wales and Monmouthshire, (4) Scotland. (Cmd. 4728.) Pp. 240. (London: H.M. Stationery Office, 1934.) 3s. 6d. net.

## Principles of the Art of Electrical Communication

*Signals and Speech in Electrical Communication.* By John Mills. Pp. vi+281. (New York: Harcourt, Brace and Co., 1934.) n.p.

THE development of the methods used in communicating by electricity of recent years has been so rapid that few appreciate what has already been done and fewer still can make a guess at the nature of the developments the future has in store. In this connexion a suggestive collection of essays by Mr. John Mills will prove helpful to the ordinary reader, enabling him to understand the general principles used in the art of electrical communication and the limitations to which it is subject.

The first essay is on the 'vivisection' of speech. We may say that an engineer can now 'anæsthetise' a sound wave by means of a transmitter, lay it out on a pair of telephone wires, remove various of its components and amplify and rearrange others. We then hear to what extent the sound has become less recognisable. The Bell Telephone Laboratories have made many useful researches on the effects of distorting the wave. In the days before the advent of electrically cut records, the graver of the phonograph was operated directly by the sound waves it recorded. It was moved by a diaphragm at the base of the horn which acted like an ear trumpet in catching the sound. As a complex sound wave had to be recorded, any faint component notes had little chance of being preserved on the wax. In the process of recording the human voice and the lower notes of musical instruments, the fundamental tones lost nearly all the higher overtones and frequently some of the lower overtones. We now see that the human ear was an unrecognised but invaluable helper of the phonograph industry in its early days. Its inadequacy as an analyser of a complex musical sound explains how it could tolerate such imperfect reproductions of music.

Perfection is always expensive and in many cases is not necessary. What is done and what can be done in the way of transmitting and reproducing speech and music by means of a limited number of tones is marvellous. Experiments show that if we transmit all the component tones of speech the vibration frequencies of which lie between a hundred and three thousand, then it is easy to understand. Radio broadcasting has now for some time utilised the range to five thousand. The regulations at present limit it to this amount.

Mr. Mills discusses the question of whether an electrical system will ever transmit for us the particles necessary for taste and smell. So far, no solution of these problems has yet been suggested. Those delicate and discriminating senses which lead so directly into our emotional substrata seem destined never to reach us from a distance. Even if the chemist and the psychologist could reduce the range of these senses to a limited number of elementary sensations, the synthesis seems to require at the receiving end the actual presence of the necessary elements. On the other hand, the sense of feeling presents none of these difficulties. Doubtless mechanisms could be devised for this purpose by striking blows and exerting pressures, but it is difficult to see any useful end that would be served.

The essay on modulation, which the author calls the marriage of currents, gives a clear picture of what is meant by carrier currents. The marriage of two harmonic currents, one with a frequency of twelve and another with a frequency of two, gives rise to two offspring, one with a frequency of 14 and the other with a frequency of 10. A carrier current and two side band currents surge backwards and forwards according to their respective frequencies. The carrier current comes from the generator, and the current to modulate the carrier from the telephone line from the studio. The intelligence is carried by the side bands. International regulations do not allow these bands to extend over a width of more than five kilocycles above and below the licensed carrier frequency. The operation of demodulation, that is, of detecting the original modulating current, is more complicated and requires delicate adjustments.

The further a telephone signal proceeds from its source the weaker it becomes. In technical language, this is called attenuation. Heaviside, by analysing the causes of attenuation, saw that this could be largely overcome by loading, that is, by putting inductance coils in the line. Then came the notion of electrons, which clearly explained the Edison effect and the Fleming valve and led to the repeater valve, which enables signals to be sent over thousands of miles.

Good manners over the telephone have been so fostered by telephone companies and business organisations that they have become almost universal. Consequently the possibility of countering telephone discourtesy has been little appreciated. A person who after calling has left his telephone for an inconsiderate time, while nominally seeking some desired information, might be hurried by making the telephone make a brief howl. To do this, all that is generally necessary is to hold the telephone against the mouthpiece. With a handset this would of course be as impossible as whispering into one's own ear. The principle used is the same as that of a repeater,

which makes a receiver talk into a transmitter and then amplifies the sound.

When hearing is under consideration, it is convenient to describe sounds by the number of steps above a sound which is just audible and gives the threshold of hearing. The telephone engineer describes sound by the number of 'decibels' above the threshold. For the layman it is sufficient to remember that for every ten decibels there is a tenfold increase of power, and that an increase of three decibels, which corresponds approximately to doubling the power, is about the smallest increase that he is able to detect. His ears, for frequencies lying between 500 and 2,000 cycles per second, the range where hearing is keenest, can accommodate themselves to sounds extending about 130 decibels above the minimum audible intensity. For more intense sounds, auditory perception is masked by pain and the threshold of 'feeling' is reached. This also is about the level of the noise in busy streets. Near an aeroplane engine, the noise will be about thirty decibels higher than in a busy street. The ears of listeners will therefore be subjected to a sound power a million times larger. In a quiet suburban garden, the noise level may be only ten or twenty decibels above the level of zero sensation.

## Science or Propaganda?

*Heredity and the Social Problem Group.* By E. J. Lidbetter. Vol. 1. Pp. 160+26 plates. (London: Edward Arnold and Co., 1933.) 21*s.* net.

THE book before us is based on an extremely painstaking study of persons receiving assistance from the Poor Law authorities in an area of East London, and their relatives. The results are embodied in twenty-six pedigrees, some of which contain several hundred individuals. They are classified according to the amount, if any, of assistance received from the rates, and also on a basis of physical and mental defects and of criminality. The investigation has been going on since 1913, and the author must be congratulated on his industry. A second volume is promised, dealing with a control group, and drawing conclusions. It may be hoped that this volume will include a statement of the criteria employed in assessing mental defect, and also as to the proportion of the whole pauper population which is included in these records. Unless this proportion is quite high, it is obvious that false conclusions may be drawn from the selection of the material.

The author states "that in this volume nothing more is attempted than to present a record of comparable facts, and that generalisations and analysis are reserved to a later volume". If this were true, the work would be a valuable social document. But it is far from true. The title alone begs two questions. It seems to be assumed that where undesirable characters occur in several generations we are concerned with heredity. This is no doubt true of the blindness in pedigree I, and highly probable in some other pedigrees. On the other hand, the frequent mention of venereal disease makes it clear that a good deal of the blindness, mental defect and insanity was due to this environmental cause. We find various defects among children brought up in Poor Law institutions and in conditions of great poverty. In view of the known effects of diet upon mental and physical health, it would be more possible to assess the part played by heredity in the causation of these defects if a few typical dietaries were given. For example, it would be interesting to know how much milk was drunk per week in 1900 by a five-year-old child in a typical family of this group. The author makes no suggestion that malnutrition may have played any part in determining the defects with which he deals.

The term 'social problem group' is applied to a small group who under pre-War conditions were chronically unemployed. Since 1921, this phrase has been out of date. Our main social problem to-day is the unemployment of persons able and willing to work, and the social problem group to-day is the group responsible for this fact. Some economists blame the owners of unused bank balances, others the technicians whose inventions have displaced labour; whoever else is to blame, the subjects of this book are not.

In spite of his disclaimer, quoted above, the author has been guilty of the most startling generalisations. Of the irregular unions common among his subjects he writes: "Such conditions may exist in other sections of the community, but if so they are unknown to the writer". A study of divorce decrees might convince him that unions of this type are frequent among certain sections of the rich. Again, Mr. Lidbetter believes in "the impossibility of considering biological problems upon an examination of pedigrees consisting only of two or even three generations". Yet our knowledge of the inheritance of blood group membership and taste-blindness is entirely built on such pedigrees. For such reasons as these, we must question the author's deductions from the data presented.

Even if the pedigrees show inheritance, it is not clear what is inherited in most cases. The people concerned were ill-adapted to life in East London. But one who (p. 87) had "spent most of his life in the workhouse, or in prison" rose to commissioned rank in the army, and ceased to be a burden on the rates; that is to say, he was a success in a different environment. Unless the

author contemplates the permanency of the East London environment, he has no more right to describe most of his subjects as socially inadequate because they failed there, than to describe a Jersey cow as agriculturally inadequate because she fails on the South African veldt. Unfortunately, such considerations will not occur to all the readers of this book.

The statement on pp. 19–20 that the socially inadequate are endowed at the expense of the self-supporting community could be used for any sort of propaganda, for example, against capitalism or the drink trade. It is here applied to the chronic pauper, with the further suggestion that the inadequacy is congenital. This is as legitimate as most other political propaganda, but it seems very unfortunate that it should be carried out with funds supplied by such bodies as the Medical Research Council and the Royal Society. Moreover, the obvious political bias displayed is likely to have the opposite effect to that intended. Some members of the 'social problem group' almost certainly bear genes which would lower their efficiency in any environment, and thus present a real problem for the eugenist. Readers who disagree with Mr. Lidbetter's opinions on politics and economics will be likely to overlook this fact.

Undoubtedly many readers will disagree with the reviewer, and regard this work as an important contribution to human biology. It is unquestionably a storehouse of valuable facts, but they would have been more impressive to the reviewer had the political opinions of their collector been less obvious. Is it too late to hope that, in the promised second volume of this work, a serious attempt will be made to assess the relative importance of nature and nurture in determining the characteristics of the men and women here described? J. B. S. H.

## The Human Outlook in Botany

*Everyday Botany.* By L. J. F. Brimble. Pp. viii+589. (London: Macmillan and Co., Ltd., 1934.) 7*s.* 6*d.*

THERE is no doubt that the study of botany is less commonly regarded as of general importance than is that of chemistry and physics, which seem to touch more closely our everyday life with their direct bearings on the chemical industries, on electricity, telephony, wireless and so on. Yet a knowledge of plant life is essential to the development of agriculture, the oldest and most widespread of human occupations, and those countless individuals who cultivate allotments or seek to embellish their surroundings by trim and attractive gardens would be more successful in their pursuits if they had some understanding of the needs of the plants they grow. Unfortunately, their education in this direction has usually been neglected.

It is to be regretted that even in these days, when the importance of science in our national life is beginning to meet with more recognition, the biological sciences are still absent from the curriculum of many boys' schools. Perhaps the ordinary textbooks of botany have not convinced the headmasters of the human interest and the universal importance of the subject. Mr. Brimble has endeavoured to meet this defect in his "Everyday Botany" by including in an elementary book dealing with plant life many features which indicate the utility to man of many important plants and plant products. By emphasising the human side of botany and maintaining a wide outlook on the important practical applications of a study of plants, the author fully justifies the publication of a new textbook, which it is to be hoped will meet with a warm welcome.

It is natural and fitting that the treatment of the subject matter should have a physiological bias, for it is the life of the plant which is of prime importance in considering its cultivation. But a knowledge of its structure is essential too, for structure and function of the various organs go hand in hand. Both aspects are adequately dealt with and the text is clear and readable, continually lightened for the general reader, for whom the book is primarily written, by reference to interesting facts which should be of common knowledge, but unfortunately are not. The treatment remains, however, always scientific, and the scope of the book is sufficiently comprehensive to serve as an adequate preparation for the various School Certificate and Matriculation examinations. One of the features which will attract both pupils and teachers is the wealth of illustrations, a large number being reproductions of excellent drawings by the author.

Having dealt with the plant as a whole, Mr. Brimble devotes a special chapter to the plant and its surroundings, an attractive introduction to the modern branch of botany known as ecology. This is followed by a chapter on evolution and plant-breeding, which fittingly indicates one of the paths of future progress in agriculture and horticulture. In this chapter, as indeed throughout the book, the author indicates by reference to former and present investigators the course of the development of botanical science, and manages to convey to the mind of the reader that botany is a progressive science and that it has its part to play in the progress of human affairs. In this as in other ways the book is stimulating in its effect upon the reader, and it will without doubt be found most useful to all who wish to acquire a knowledge of plant life.

## Short Notices

*Index Kewensis Plantarum Phanerogamarum.* Supplementum Octavum Nomina et Synonyma Omnium Generum et Specierum ab initio Anni MDCCCCXXVI usque ad finem Anni MDCCCCXXX nonnulla etiam antea edita complectens. Ductu et consilio A. W. Hill. Confecerunt Herbarii Horti Regii Botanici Kewensis Curatores. Pp. iii+256. (Oxford: Clarendon Press; London: Oxford University Press, 1933.) 75*s.* net.

THERE is always a welcome for a new supplement of the "Index Kewensis", which supplies the botanist with a list of the names of genera and species published during a five-year period, and thanks are due to Miss Green and Dr. Sprague of the Kew Herbarium for the skilled and careful labour involved in its compilation. A useful innovation in this eighth supplement is the inclusion as an appendix of an alphabetical list of new or previously overlooked generic names under their respective families.

In the "Index" the name of the genus is followed by an indication of the family to which it belongs; new specific epithets are followed by the name which, in the opinion of the author, it should replace. Hybrids are also indicated. Appreciation of the rule that requires a Latin diagnosis to ensure validity of a new name is expressed, as in the case of the various Kew floras, by the additional reference which renders it valid. There is a fair sprinkling of *nomina nuda*—mere ghosts without body—and as botanists have agreed to neglect these it seems unnecessary to index them. A bad case is found under *Mentha*—of 60 entries 39 are *nomina nuda*.

It would be of interest to estimate the proportion of novelties represented by the new names but this varies widely from page to page. A small proportion only of those of genera represent plants new to science; mainly are they expressions of new views, to a large extent individual and sometimes conflicting, as to the limitations of genera; the long lists under the families Ficoidaceae and Leguminosae are striking examples. These alterations are responsible for correspondingly long lists of new combinations in the index of species. For number of entries *Hieracium* (hawkweeds) takes the prize, filling eighteen columns of 'novelties' nearly all from Norway and Sweden. We extend our sympathy to the Scandinavian botanists.

It is no faint praise to say that the new "Index" is as interesting reading as is a dictionary. It mirrors present tendencies of views on taxonomy as well as records the progress of monographic work and the botanical exploration of less-known parts of the world. A. B. R.

*Exploring the Unconscious: Further Exercises in Applied Analytical Psychology.* By Dr. Georg Groddeck. Pp. 224. (London: The C. W. Daniel Co., 1933.) 7*s.* 6*d.* net.

THIS excellently translated provocative book consists of a selection from the writings of Dr. Groddeck. For him, life is greater than its manifestations and the human being than his symptoms. While his profession as physician provides his problems and so far determines their expression, it does not limit his outlook. To him all human activities are the work of some unknown, called by him the 'It' as the most impersonal word available, and if we would understand illness, mental or physical, literature, art and music we must learn the language by means of which this unknown expresses itself, frequently a difficult cipher for which we have no ready-to-hand key. The physician trying to interpret bodily symptoms is advised not to overlook the unconscious factors and he is shown that the very method that will help him in this will also illumine the problems of Faust, Peer Gynt and the "Ring", as well as some vexed riddles of philology, of music and art.

Some of the symbolism among which Dr. Groddeck moves with ease will be beyond many readers, but will provoke others to test it for themselves. He emphasises to a much greater extent than most psycho-therapists the importance of synthesising as well as analysing, and the rôle of repression is far more adequately dealt with than elsewhere. The ideas to some will seem fantastic, to others alluring: to all whose work demands an interest in human beings his general conceptions are worthy of consideration, at least, as hypotheses to be tried out.

An interesting and attractive personality reveals itself in this unusual book, and the translation is so good that one is not aware that it is not in its original form.

*Plane and Geodetic Surveying: for Engineers.* By David Clark. (Glasgow Text Books of Civil Engineering.) Vol. 2: *Higher Surveying.* Second edition, revised and enlarged. Pp. xii+312. (London: Constable and Co., Ltd., 1934.) 25*s.* net.

THIS work is already well known as a standard book on the subject of geodetic surveying; and the new edition should go far to uphold the reputation of the old. The diagrams and photographs are clearly reproduced, and the subject matter is set out in a readable manner. The problems set at the end of each section are extremely useful, and possess the advantage of having the answers appended to them. It would perhaps have been preferable to use letters on the illustrations of such instruments as the theodolite in order to show the constituent parts more clearly; no description of the application of aerial photography to modern surveying is included, and the section dealing with map projections seems to be somewhat condensed. The difficult question of the rapid adjustment of errors in triangulation surveys is admirably dealt with, especially by the method of conditioned quantities.

Altogether, this work can be described as well suited to the needs of students reading for pass and honours degrees in engineering, and for those who desire more detailed knowledge of advanced surveying than is given in the usual textbooks. B. H. K.

# Polarimetric Methods in Chemistry*

By PROF. T. M. LOWRY, C.B.E., F.R.S.

## MUTAROTATION

NEARLY forty years ago, as a student of organic chemistry under Prof. H. E. Armstrong, I undertook my first research, on the stereochemistry of the α-derivatives of camphor. The earliest experiments showed that the bromination of α-chlorocamphor and the chlorination of α-bromocamphor both gave an isomorphous mixture of stereoisomeric αα′- and α′α-chlorobromocamphors. It was then natural to extend the research to the nitro-derivatives. For this purpose it was necessary not only to nitrate bromocamphor, but also to brominate nitrocamphor. In this way I first encountered the nitrocompound, $C_{10}H_{15}O.NO_2$, which has already provided a material basis for two extensive series of researches, and has not yet exhausted its utility or interest.

The first of a series of happy chances was a measurement of the optical rotatory power of a solution of nitrocamphor in the morning, followed by a confirmatory reading in the afternoon. During the luncheon interval the rotatory power of the solution had become quite different, and I was thus presented with a novel example of the phenomenon of change of rotatory power with time, which Dubrunfaut had first observed in 1846 in a freshly prepared aqueous solution of glucose. This property of the reducing sugars had been variously described as birotation, multirotation, and paucirotation, according as the ratio of the initial to the final rotation was 2 : 1, greater than 1 or less than 1; but, since in certain solvents the *sign* as well as the magnitude of the rotation of nitrocamphor was changed, I suggested in 1899 that the phenomenon should be described as *mutarotation*; and this name has been in general use ever since.

The chemical basis of the phenomenon was disclosed by another happy accident. Wishing to know whether the change of rotatory power could be repeated when the nitrocamphor had been recovered from solution, I left a solution in benzene to evaporate on the water bath. Later in the day I examined the residue and found that it was now almost entirely insoluble in benzene. It had in fact been converted into a new compound, an anhydride formed from nitrocamphor by the loss of half a molecular proportion of water. An anhydride of this type could not be formed directly from nitrocamphor itself, but it could be derived easily enough from an isomeric hydroxylic form of the substance, such as that from which the salts of nitrocamphor were presumably derived. This conclusion was confirmed by the fact that the anhydride of lævorotatory nitrocamphor was, like the salts, strongly dextrorotatory. The mutarotation of nitrocamphor, always from left towards right, could therefore be attributed to a partial conversion in solution of lævorotatory nitrocamphor into a dextrorotatory isomeride, containing an acidic hydroxyl group, which was capable of forming an anhydride as well as a series of salts.

At this stage, Prof. Kipping very generously gave me a quantity of the π-bromo-derivative of α-bromonitrocamphor, from which I was able to prepare a stock of π-bromonitrocamphor. Lapworth and Kipping had described this compound as trimorphous, and had recorded the crystal constants and published drawings of two of the forms. The orthorhombic form, melting at 142°, proved to be strongly dextrorotatory when dissolved in benzene, but it became lævorotatory after a few hours. The tetragonal form, melting at 108° (which is formed as a by-product, alongside the more stable form, by rapid evaporation of a solution in chloroform), was found to be lævorotatory, but like nitrocamphor it exhibited a relatively small mutarotation from left towards right. This labile form was therefore analogous with ordinary nitrocamphor, whilst the more stable form was analogous with the still unknown pseudo-nitrocamphor, the relative stability of the two isomers having been reversed by the introduction of a halogen. The third form, for which no crystal measurements had been published, was evidently a mere mixture of these two isomers.

The mutarotation of the sugars in aqueous solutions had been attributed to several causes; but, when Emil Fischer observed the same phenomenon during the reversible hydrolysis of the sugar lactones, he concluded that these changes of rotatory power were due to reversible hydration, and this conclusion was very widely accepted. This explanation can obviously be applied to any aqueous solution in which reversible hydrolysis can take place; but it was not applicable to nitrocamphor, which exhibited mutarotation in a large range of anhydrous solvents, but was too insoluble to be examined in aqueous solutions. Since interaction with the solvent was thus excluded, the mutarotation of nitrocamphor could only be attributed to *dissociation* or to *isomeric or polymeric change*.

* From the presidential address entitled "Physical Methods in Chemistry" to Section B (Chemistry) of the British Association, delivered at Aberdeen on September 6.

At that date, certain sugars had already been prepared in two isomeric forms, which exhibited mutarotation in opposite directions; but these changes were attributed to the complete conversion of the two sugars into a third isomeride. In the case of π-bromonitrocamphor, however, the product of mutarotation of the normal and pseudo forms was obviously an equilibrium mixture of these two substances, and not a third isomeride, since, on evaporation of the solution, crystals of the normal and pseudo forms were deposited side by side. Mutarotation was therefore attributed to the *reversible isomeric change* of two isomers; and this interpretation was regarded as generally applicable to mutarotations in which interaction with the solvent could be excluded.

### Dynamic Isomerism

The phenomenon of reversible isomeric change had been studied, and its essential characteristics had been fully elucidated, twenty-two years before by Butlerow in 1877. He had shown that two isomeric forms of the unsaturated hydrocarbon, *iso*dibutylene, $C_8H_{16}$, could be brought into equilibrium by the reversible addition of sulphuric acid, since a molecule of sulphuric acid could be removed from the acid sulphate in two different ways. Simultaneously, two *iso*dibutyl alcohols of the formula $C_8H_{18}O$, in the form of their acid sulphates, were brought into equilibrium by the reversible elimination of sulphuric acid, since the resulting olefine could add on sulphuric acid in two different ways:

$$C_8H_{16} + H_2SO_4 \rightleftharpoons C_8H_{17}O.SO_2.OH$$

Butlerow also recognised that, although sulphuric acid was required to bring the isomeric olefines and alcohols into equilibrium, the introduction of a catalyst might not be required in other cases. In particular, he suggested that prussic acid might be regarded as an equilibrium mixture of the two acids, HCN and HNC, from which the cyanides and *iso*cyanides $CH_3.CN$ and $CH_3.NC$ are derived:

$$CH_3.CN \leftarrow HCN \rightleftharpoons HNC \rightarrow CH_3.NC$$

Methyl cyanide. Prussic acid. Methyl *iso*cyanide.

Butlerow's paper did not receive the attention that it deserved, perhaps because it was published under the too modest title "On Isodibutylene". Much more interest was aroused by the publication, eight years later, by Laar, of a speculative paper "On the Possibility of Several Structural Formulæ for the Same Chemical Compound". Laar assumed that the dual reactivity of certain substances, of which ethyl acetoacetate is now the most familiar example, might be due to the incessant wandering of a hydrogen atom between two alternative positions in the molecule. In order to make his theory more precise, he compared these internal migrations with the vibrations which give rise to radiation in incandescent gases. To this phenomenon he gave the name of *tautomerism*, and in order to emphasise the contrast with Butlerow's phenomenon of reversible isomeric change, he stated categorically that the substances represented by the two alternative structural formulæ were "not isomeric but identical".

Since two isomeric forms of π-bromonitrocamphor had been isolated in the crystalline state, and their slow progress towards equilibrium in solution had been followed by observations of mutarotation, it would have been absurd to describe them as identical, or, in terms of Laar's definition, as tautomeric. These well-defined compounds, however, provided an excellent illustration of Butlerow's phenomenon of "equilibrium between isomers". I therefore ventured to describe this phenomenon in very obvious terms as *dynamic isomerism*, in contrast to the more usual condition of static isomerism, in which each isomer preserves its individuality and is not in process of conversion into any other substance of similar composition.

(*To be continued.*)

## The Metamorphosis of Paper

ONE of the results of the application of scientific methods to the cellulose industries, and in particular to paper, has been a realisation of the considerable inherent strength of the unit fibre. One would, of course, hesitate to select paper for any purpose for which great strength is essential, but at the same time it must be remembered that, when paper is broken, it is usually the bonds connecting the fibres, and not the fibres themselves, which are ruptured. Reliable figures are necessarily difficult to obtain, but actual measurements indicate that, weight for weight, the tensile strengths of certain cellulose fibres and of wires made from light metals are of the same order (cf. NATURE, 131, 553, April 15, 1933).

It is not unnatural, therefore, that many attempts have been made to produce paper products having the equivalent in strength and durability of more resistant materials such as cloth, leather, wood and even metal, and in such cases attention has usually been concentrated on strengthening the bonds between the fibres both laterally and longitudinally, on the reasonable assumption that the individual fibres can take care of themselves. By selecting the strongest of

fibres and treating them mechanically in the paper-mill beater, it is possible to split the ends of the fibres into smaller fibrillæ which intertwine on the paper-machine and develop considerable strength, but there is obviously a limit to the extent to which this can be carried, and this limit precludes paper completely as a competitor even to a woven fabric.

The most promising results have been obtained by processes of impregnation, in which the fibres are held together by addition of an independent consolidating material. Thus, if paper is passed through zinc chloride or sulphuric acid under controlled conditions of concentration and temperature, the cellulose is modified in such a way as to form a hard impervious surface layer. This so-called 'vulcanising' process not only imparts a certain amount of strength and solidity to the sheet, but also, if a laminated product is made by pressing sheets into intimate contact before the hardening process is complete, a hard material having many of the properties of wood is obtained. Materials of this type, for example, fibrous plasters, mixtures of paper and glue, and laminated paper products made by impregnation with synthetic resins, have been available for many years, but have not hitherto been obtainable in the form of a strong flexible sheet.

The methods suggested for strengthening fibres by simple immersion in a bath occupy a share of the patent literature far out of proportion with the value of the material they produce. There are, however, several outstanding exceptions, one of which is rubber. Absorbent paper containing more than 90 per cent of α-cellulose can be heavily impregnated with rubber either as a latex suspension or dissolved in a solvent, and the resulting product, when suitably coloured, finished and embossed is an excellent imitation of leather or cloth, from the point of view not only of appearance but also of strength and durability.

Another very successful product, but of a rather different character, is "Linson", which is described as a cellulose fabric. This gives a partial clue to its identity, although the base material is manilla, which is one of the strongest vegetable fibres known. The great strength of Linson is indicated by the fact that the folding-resistance is almost ten times that of an ordinary bookbinding cloth. The difficulty of producing a high-glazed, water-repellent finish without brittleness seems to have been overcome, and not only is it possible to scour or polish the surface without damage or removal of colour, but also the resistance to oil and petrol gives it a considerable advantage over the numerous cellulose lacquers at present available for waterproofing. Resistance to water is usually and for obvious reasons incompatible with suitability for work with adhesives, but Linson must be ranked with the few products of its kind which fulfil both requirements satisfactorily. Apart from alkalis, fairly strong acids and certain organic solvents (which may be regarded as unfairly stringent tests) we have found only one medium which it will not resist without change, and that is hot water; the effects of storage and weathering have, however, yet to be tested.

Numerous uses for this class of material at once suggest themselves, but mention may be made here of all kinds of substitutes for the poorer and thinner varieties of leather, for bookbinding material, motor-car roofings, desk-tops and (since it can be sewn, washed, ironed and blocked) even for clothes.

J. G.

## Recent Aeronautical Research

THE annual report for 1933–34 of the Aeronautical Research Committee covers the work of the first year under the new chairmanship of Mr. H. T. Tizard.* It summarises the position to-day with regard to actual flight that "flying may now be regarded as a safe means of transport. This is due on the one hand to the steadily increasing reliability of aircraft engines, and on the other to the satisfactory development of rules of design." The Committee suggests that the relative immunity from accidents has been largely attained by the age-long process of trial and error, which has not been without its cost in loss of life. It is probable, however, that there is no other industry in applied science that has had quite so much scientific thought given to both its fundamentals and the elucidation of its errors in application of them. Hence the relatively rapid progress in both of the outlooks that the Committee considers has led towards safety is in itself due, in no small degree, to its own work.

Paradoxically, the report then discusses a series of accidents that have been happening to one particular type of aircraft, and admits that the trouble is not yet completely solved. Experiments on a model with specially made wings of the correct proportional elasticity are now in progress as an attempt to reproduce the apparent conditions under which these failures occurred. Such accidents cannot be entirely disassociated from existing weather conditions, and work has been undertaken in an attempt to measure such

* Aeronautical Research Committee. Report for the Year 1933–34. Pp. iv+89+4 plates. (London: H.M. Stationery Office, 1934.) 1s. 6d. net.

conditions in flight. The net result of the observations made suggests that only during one flight in 10,000 in western Europe is an aircraft likely to encounter disturbances in the air that would have an effect equal to meeting an upward gust with a velocity of 30 ft. per second. All aeroplanes as at present designed are strong enough to meet such a gust. This throws a sidelight upon the proportionate risk that is attendant upon flying. It would be interesting to compare it with the number of trips made by, say, a London motor bus, or a train on a British railway, per structural breakdown.

In a similar connexion, a reference is made to a report by the Director of the Meteorological Office on the effects of lightning on aircraft. In no instance has there been a fatality occurring as the result of a British aeroplane being struck by lightning, while damage to the structure is usually slight. This paper has been published by the Meteorological Office (Professional Notes, No. 66: Lightning and Aircraft. By G. C. Simpson. London: H.M. Stationery Office, 1934. 4*d*. net. See NATURE, Oct. 20, p. 618).

The spinning of aeroplanes has resulted in a number of accidents in previous years. Various ways of avoiding the dangers of a flat spin which sometimes arises during a normal spin, and from which it is difficult to recover, are mentioned in some detail. The new free spinning tunnel at the Royal Aircraft Establishment has been of considerable assistance in these investigations. In this tunnel, in which the air flows vertically upwards, a model can be left to spin freely and its behaviour observed. It is now considered that the problem is sufficiently understood to justify giving further experiments a lower priority than formerly.

A curious contradiction has arisen with regard to safety during landing and take-off. The increase in the wing loading and the general improvement in stream-lining of aeroplanes has increased the difficulties associated with these two manœuvres. It is possible under certain conditions to propel the aeroplane into the air by its own momentum before it is aerodynamically supported. The complete understanding of this problem and many others relative to control calls for a very thorough knowledge of the flow of air over wings in the stalled condition. This has been investigated principally at Cambridge. A picture of the air flow has been obtained by watching the behaviour of tufts of wool attached to the surface. When the flow is steady the tufts lie out along the wing, but when turbulent they wave about in a violent manner. This technique is proving useful for the study of air flow in many different ways.

Investigation into the properties of the autogiro has also been carried out during the past year. The new type, which is wingless and has no rudder or elevators, is considered to be a great advance on previous designs, especially from the point of view of safety in flight. It can not only land, but also take off in a very small space, and is particularly simple to control. Its minimum flying speed is about half that of a conventional type of aeroplane, and it is quite stable. For commercial purposes it may not be so efficient as the aeroplane. The Committee states that it is now examining the theory of the autogiro in more detail in order to find out whether there are any unusual conditions of flight when it may become unstable and dangerous.

The Committee has also considered proposals for the construction of cyclogiros or paddle-wheel aeroplanes. The outstanding problems on these aircraft are, in its opinion, that of difficulty of construction with reasonable weight rather than aerodynamics.

With regard to the work on aero-engines, the most promising lines of advance seem to be in single-sleeve valve engines; an illustration in the report shows the remarkable decrease in the number of parts to a sleeve valve cylinder of a radial air-cooled engine compared with the more normal design with a poppet valve cylinder. Work is proceeding also on compression ignition engines of the sleeve valve type. Consideration is being paid to possible replacement of carburettors in petrol engines by injection pumps, although there does not appear to be any fundamental advantage in the latter.

Lubrication is also mentioned, although with no very definite proposals up to the present. The difficulties of laying down a specification for a good lubricating medium are appreciated, not the least of these being to find out exactly what functions the engine user demands of the lubricant. Experiments have shown that the use of 'inhibitors' will delay the formation of gum on cylinders and pistons, and it is hoped to prevent the formation of sludge by similar means.

Certain progress is mentioned in the metallurgy of those metals of interest to the aeronautical engineer. The subjects investigated include elasticity and fatigue, the use of beryllium, magnesium alloys, corrosion prevention, etc.

A supplement of about seventy pages gives details of the year's work in aeronautical research under individual sub-headings as follows:—(i) Aerodynamics; (ii) fluid motion; (iii) stability and control; (iv) servo controls; (v) spinning; (vi) seaplanes; (vii) atmospheric turbulence and meteorology; (viii) structures; (ix) aircraft noise; (x) engines; (xi) elasticity and fatigue; (xii) alloys.

## Obituary

### Prof. Willem de Sitter

ASTRONOMY has suffered a heavy loss by the death of Willem de Sitter, director of Leyden Observatory. In the development of astronomical research in the present century, Holland has taken a conspicuous part; and, since the death of J. C. Kapteyn, de Sitter has been the leading astronomer of his nation. He is most widely known as the propounder of the 'de Sitter universe', a recondite development of the theory of relativity which is the basis of our present idea of an expanding universe. But that reveals only one side of his versatility. The great research, which occupied him for thirty years, was in classical celestial mechanics; and in 1931 the Royal Astronomical Society awarded him its gold medal "for his theoretical investigations on the orbits of the satellites of Jupiter, and for his contributions to the Theory of Relativity". It is a strange chance that, of his most conspicuous contributions, one should relate to the Jovian system—first-fruits of the invention of the telescope—and the other to the remotest systems that the telescope has yet revealed. But, setting aside his personal research, astronomers more usually think of him as the energetic head of a flourishing observatory, who by his sound practical judgment, his wide experience, and his single-minded character, has had a far-reaching influence on the general advance of astronomy.

Willem de Sitter was born at Sneek in Friesland on May 6, 1872. He was educated at the Gymnasium at Arnhem, where his father was a judge, and at the University of Groningen. Though primarily a mathematician, he was captured by Prof. Kapteyn's enthusiasm and began to work in the Astronomical Laboratory at Groningen. It was, however, Sir David Gill who finally converted him into an astronomer. Visiting Groningen in 1896, Gill made his acquaintance, and eventually invited him to the Cape to assist in the discussion of the heliometer observations of Jupiter's satellites. De Sitter found the Jovian system a subject after his own heart; it gave scope both to his mathematical training in celestial mechanics and to his later interests in the practical side of astronomy. He worked at it more or less continuously until 1929, when at last he felt satisfied to publish his definitive values of the orbital elements and masses of the four satellites.

After two years at the Cape Observatory, de Sitter returned to Groningen and became an assistant in the Astronomical Laboratory. In 1908 he succeeded H. G. van de Sande Bakhuyzen as professor of astronomy in Leyden. On the death of E. F. van de Sande Bakhuyzen in 1918, he was appointed director of the Leyden Observatory. This was an important and arduous post, for the Dutch Government had decided on a great enlargement and reorganisation. Leyden is one of the oldest observatories; its third centenary was celebrated last year; but for many years it had ceased to be an important institution. De Sitter applied himself to the reorganisation with energy and far-sightedness, and sacrificed his personal work to the responsibilities of his office. Surrounding himself with a well-chosen staff, he rapidly made the Observatory one of the most important in Europe. This success was fittingly recognised when he was made president of the International Astronomical Union for the period 1925–28.

One interesting innovation was the alliance which de Sitter formed in 1923 with the Union Observatory at Johannesburg, providing for regular visits of members of the Leyden Observatory to gather observational material in the favourable climate of South Africa. Leyden will shortly have its own instrument installed at the Union Observatory, namely an equatorial with twin photographic telescopes of 16-inch aperture having Cooke triplet objectives. The instrument is now ready for testing, and de Sitter was planning just before his death a visit to England to inspect it.

In 1916–17, de Sitter published a series of three papers in the *Monthly Notices of the Royal Astronomical Society* "On Einstein's Theory of Gravitation and its Astronomical Consequences". These were the first papers in English on the new theory. Einstein's original paper was almost inaccessible here, owing to the interruption of international communication; probably the only copy in England was one which de Sitter kindly sent to the present writer about this time. There were already a number of developments to be added. De Sitter's papers included an admirable up-to-date exposition of the mathematical theory; and they have greatly influenced the form in which the general theory of relativity has come to be understood in England. In the second paper, he investigated the effect of the new law of gravitation on the motion of the moon, and found that it would cause an advance of the perigee and node amounting to nearly 2″ per century; this is at present just outside the limits of practical detection. The analysis in the paper is very arduous, and shows how fully de Sitter had entered into the methods of the new theory. A simpler way of handling the problem has since been discovered, but it confirms de Sitter's conclusion.

It is in the third of these papers that the 'de Sitter universe' appears as a suggested alternative to the 'Einstein universe'. It is perhaps necessary to explain how these ideas arose. It has become the regular procedure in mathematical physics to express the laws of Nature by differential equations. But in classical physics at least the differential equation is not the whole of the law; boundary conditions are also prescribed. Thus it is not sufficient to say that Newton's law of gravitation is $\nabla^2\varphi = -4\pi G\rho$; there is the further condition that that solution of the differential equation must be taken which makes $\varphi$ zero at infinity. Tested by the principle of relativity, the Newtonian equation failed; Einstein had to substitute another differential equation, and so reached his famous theory. But what is sauce for the goose is sauce for the gander, and the boundary values at

infinity should also be tested by the same principle. Unfortunately, they did not satisfy the test. In particular, the familiar solution giving the gravitational field of the sun (which affords the chief observational tests of the theory) gives values at infinity which are open to this criticism. Einstein was the first to recognise this inconsistency, and proposed a remedy. De Sitter pointed out that there was an alternative which in some ways appeared less artificial. He entered into a full discussion of the astronomical phenomena which might be used to discriminate between them. Both theories lead to a closed spherical space, and de Sitter's paper contains estimates of upper or lower limits to the size of the universe on either hypothesis. It is a reminder of our progress in the last seventeen years that none of these estimates is large enough to include some of the nebulæ the distances of which have recently been measured.

De Sitter pointed out that the most definite test would be provided by the velocities of the spiral nebulæ. In his cosmology, but not in Einstein's, the velocities should increase with increasing distance. He does not seem to have noticed that the velocities should all be recessive, though this is almost immediately evident from his formulæ. It is true that he predicted a systematic displacement of spectral lines to the red, due not to genuine motion but to a 'slowing down of time' at great distances from us. This is now recognised to be only a second order effect, and is submerged in genuine increase of receding velocity with distance. We need not here trace in detail how the present version of the expanding universe differs from de Sitter's original account; the differences are such as naturally arise in the course of development of a highly original idea. Confronted for the first time with the topsy-turvy conceptions to which his pioneer work had led, de Sitter was amazingly far-sighted on some points and amusingly blind on others. He appreciated as much as anyone the joke that some of the most surprising properties of his universe arose from the fact that he had forgotten to put any matter into it.

The de Sitter universe attracted the attention of geometers as well as physicists, and became a favourite theme of study. De Sitter took little part in this himself. By the time the radial velocities of spiral nebulæ had been determined in sufficient numbers, he was heavily occupied in reorganising Leyden Observatory. For at least ten years he was "the man who discovered a universe and forgot about it". But in 1930, having at last completed his work on the Jovian system, he returned to the subject. Learning later of Lemaître's development of the theory, he accepted it with enthusiasm and published a number of papers on the problems raised. An interesting summary of his later views is given in the last chapter of his book "Kosmos", which contains the Lowell lectures delivered by him at Boston in 1931.

Astrophysics, as ordinarily defined, was outside de Sitter's range; but he took care to secure in his observatory a strong astrophysical department directed by Prof. Hertzsprung. His activities included most other branches of astronomy—dynamical, statistical, instrumental. He did much work on the fundamental constants of the solar system. His work on Jupiter's satellites led him to contribute to the examination of the secular retardation and irregularities of the earth's rotation, using the early observations of these satellites to check the earth's performance as a time-keeper.

Both for his ability and his character, de Sitter was highly esteemed by his colleagues. He was a frequent and welcome visitor to England. He attended and took part in several meetings of the British Association, including the two meetings held at the Cape. He was far from robust, having suffered a long and severe pulmonary illness about 1921 which left him with a damaged lung; but he did not spare himself in activity. He looked older than his years. Outside astronomy he was much interested in art and literature; but his greatest joy was in his home life with his children and grandchildren. He had two sons and two daughters, all married.

On November 9 of this year he became seriously ill with pneumonia, at the same time with two other members of his family—a son and grand-daughter who had just returned from the Dutch Indies. The child died on November 16, but it was hoped that de Sitter would recover. On November 18, complications set in and he grew rapidly weaker. He died on November 19. A. S. E.

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### The Rev. A. H. Cooke

Alfred Hands Cooke was born at Enfield in 1854. He was a colleger at Eton and proceeded as a scholar to King's College, Cambridge. Here he crowned a classical career of unusual brilliance by being Senior Classic in 1878. The following year he was elected a fellow of King's, where he remained as dean and tutor until 1900.

Cooke's scientific work was almost exclusively confined to the study of the Mollusca, and in this branch of zoology he soon attained a position of widely recognised authority. He was University curator of zoology from 1881 until 1890 and in 1895 published his best-known book—the entirely charming volume on Mollusca in the Cambridge Natural History. But he did much other work of a more technical nature and the value of his many papers on conchology was acknowledged by the degree of Sc.D. conferred on him by the University in 1914. He was president of the Malacological Society in 1913–15 and of the Conchological Society in 1919–20. His large collection of shells, many of them taken by himself in foreign travel, he had recently presented to the British Museum. This collection includes a very long series of the whelk, *Purpura lapillus*, from all parts of the world. It shows the extreme variations of the species and contains a sinistral variant, a Hungarian specimen and one of the four or five recorded examples.

For twenty years after leaving Cambridge, Cooke was headmaster of Aldenham, where he produced a steady stream of fine classical scholars of his own training, and continually encouraged and extended

the teaching of science. He was an impressive preacher and an exceptionally fine lecturer, and to many generations of his boys the memory of his personality will ever remain one of the most powerful influences of their lives.

Cooke was, indeed, one of the really great men who touched nothing that he did not adorn. He had no mean reputation as a classical scholar and his dual record—Senior Classic and Doctor of Science of Cambridge—must be unique. In 1920 he retired to the Eton living of Mapledurham, where, attracted to the study of archæology, he quickly mastered a new subject and produced, in 1925, his fascinating book, "The Early History of Mapledurham". It was here that he died on November 28. T. H. S.

We regret to announce the following deaths:

Dr. Aristarch Belopolsky, vice-director of the Central Astronomical Observatory, Pulkovo, U.S.S.R., on May 16, aged eighty years.

Prof. O. D. Chwolson, formerly professor of mathematical physics in the University, Leningrad, on May 11, aged eighty-two years.

Dr. J. W. Leather, agricultural chemist to the Government of India in 1892–1916, on November 14, aged seventy-three years.

Dr. Theobald Smith, For.Mem.R.S., formerly director of the Department of Animal Pathology of the Rockefeller Institute of Medical Research, New Jersey, aged seventy-five years.

## News and Views

### Charles Augustus Young (1834–1908)

Among the many eminent American astronomers of last century, few were better known than Charles Augustus Young, the centenary of whose birth occurs on December 15. As a pioneer of solar spectroscopy, he was second to none, while his great gifts as a writer and teacher gained for him a world-wide reputation. Born at Hanover, New Hampshire, where both his father and grandfather had held chairs in Dartmouth College, he graduated in 1853, and then after a tour in Europe with his father, for a few years taught classics and theology. At twenty-three years of age he was made professor of mathematics in Western Reserve College, Ohio, and from that time onwards devoted himself to astronomy. The Civil War for a short time interrupted his work, but in 1866 he succeeded his father in the chair of astronomy at Dartmouth College, and eleven years later succeeded Alexander as professor of astronomy at Princeton, a position he held until his retirement in 1905. Although he made investigations of the spectra of the planets, comets, stars and nebulæ, his main interest was in solar investigations. He observed total solar eclipses at Burlington, Iowa, in 1869, at Tenez de Frontena, Spain, in 1870, at Denver in 1878, in Russia in 1887 and in North Carolina in 1900. It was in connexion with the eclipse of 1870 that he made his striking discovery of the so-called 'reversing layer'. He observed the transit of Venus of 1874 at Peking and that of 1882 at Princeton. His well-known book "The Sun" appeared first in 1881, while later he published his "General Astronomy", 1889, "Elements of Astronomy", 1891 and "Manual of Astronomy", 1902. His book on "The Sun" passed through many editions and was translated into several languages. Honours came to him from England, Germany, Italy and France, and in 1891 he was awarded the Janssen Medal of the Paris Academy of Sciences. In 1882 he served as president of the American Association for the Advancement of Science. He died at Hanover, New Hampshire, on January 3, 1908, at the age of seventy-three years.

### Present-day Scientific Research

Sir James Irvine, principal of the University of St. Andrews, in replying to the toast of the profession of chemistry at the Ramsay Chemical Dinner held in Glasgow on December 7, gave his views on some aspects of modern research. Sir James reviewed the changes which have taken place in chemical industry since the beginning of the century and referred particularly to Scotland. He said that a country which produced men like Neilson, Young, Tennant, Townsend and Watt appeared to have nothing to fear from changes in industrial conditions. But the new conditions have formed themselves too quickly, and their impact on a disorganised world has been too swift for readjustment to be entirely satisfactory or even possible. In regard to scientific training, Sir James finds himself at variance with the spirit of the times because he cannot resist the thought that scientific training in Great Britain is already over regimented. He did not refer particularly to undergraduate instruction but more to the extreme specialisation and almost mechanical quality of much of the work termed research. The ladder of research was once difficult of access and steep to climb. Only the zealots made the attempt, impelled by a force they could not control, and only the strongest survived. To-day no training is reckoned complete on first graduation, and in consequence research students, sometimes singly, more often in teams, work towards the goal of a higher degree.

Such a form of research is a costly business: it is time-consuming, and the penalties fall on those who ought to be spared. Advances in science are certainly made, but Sir James is concerned chiefly with the effect of such work on the individual and the stultification it begets in his power to think. Many students at present engaged in research would be infinitely better employed in supplementing their academic knowledge by a training in the methods whereby science is operated in industry and in the conduct of the practical affairs of life. Many professors, too, would be better professors and capable of greater

service to the world if they were allowed the leisure and peace of mind to prosecute their researches unhampered by the care and training of research collaborators. The methods of the solitary philosopher, the methods of Davy and Faraday, can scarcely be excelled. Research in the academic sense has become a fashion; it will soon become a trade and then farewell to the hopes that Great Britain will again produce the few particular men who, in a flash of genius, have turned discovery into invention and invention into industry. Scotland has given to the world such pioneers, and is not lacking in the qualities which are needful.

### Reduction of Working Hours in Industry

THE uncompromising attitude of certain sections of British industry to proposals for the reduction of working hours might be regarded with some amusement but for the serious results which it is likely to precipitate. The portentous arguments set forth, for example, by the National Federation of Employers Organisations against the forty-four hour week recapitulate in unmistakably the same accents those advanced with equal plausibility in previous generations against Factory Acts, the abolition of child labour and the limitation by law of the hours of work by women and children. There are, however, important firms such as Imperial Chemical Industries, Ltd., in its Billingham Works, and Boots Pure Drug Co., at Nottingham, which have had the courage and wisdom to determine the possibilities of the forty-hour or five-day week by direct experiment. The experiment carried out at Nottingham is of the greater interest in that its results have been made generally available in an important report by Sir Richard Redmayne, who was nominated by the Ministry of Labour, at the firm's request, to conduct an exhaustive inquiry as to whether the permanent adoption of the five-day week in all its works is possible ("A Review of the Experimental Working of the Five Days Week by Boots Pure Drug Company at Nottingham." By Sir Richard A. S. Redmayne. Pp. 70. Nottingham: Boots Pure Drug Co., 1934. 1*s*.). The publication of the full details of this investigation in itself constitutes a noteworthy break with the tradition of secrecy which has hampered the pooling of experience in matters of industrial safety, hygiene, labour policy, etc.

SIR RICHARD REDMAYNE concludes that the working of the five days working week inaugurated on April 30, 1934, and terminating on September 29, has proved an unqualified success both from the business point of view and from that of the employees. He is satisfied that the cost in the aggregate has not been enhanced and the efficiency of the employees has been increased. Marked improvements in health, contentment, regularity of attendance at work and diminution of absenteeism have been observed since the start of the experiment, and the employees themselves would view with dismay any return to the five and a half day week. Had the working hours per week not been reduced, it would have been necessary to discharge a number of workers, and from this point of view alone the experiment has already been of real benefit to the community itself. Sir Richard Redmayne is satisfied that equally satisfactory results would be obtained if the experiment was continued over the winter months. It is, of course, difficult to say how far the experiment can be applied to other concerns with equal prospects of success. The intimate relation of production and distribution in this particular concern has probably contributed largely to its success, but Sir Richard Redmayne considers that there are many works at which the five day week might be tried with equal prospects of success. Messrs. Boots have set an example in scientific experiment on a most important social-industrial question, and scientific workers should not be slow in pointing out to the community the possibility of obtaining similar decisions in these matters in other industries or concerns.

### Rare Books on Magic

AN exhibition of old and rare works dealing with magic, witchcraft, legerdemain and kindred subjects was opened on December 6 and was on view until December 14 at the University of London Council of Psychical Investigation, 13D Roland Gardens, South Kensington, London, S.W.7. Five hundred items had been selected for exhibition out of the 12,000 volumes collected by Mr. Harry Price, the honorary secretary of the Council, forming what is probably the largest and most important assemblage of printed works relating to occult subjects available for the student. The books exhibited ranged in date from about 1490 to the present day, though, curiously enough, the "Malleus Maleficarum" (1488), the first printed work on witchcraft, and the Bible of the witch finder, was not represented by a copy earlier than 1576. Works dealing with magic and the witch, ghosts and spiritual manifestations generally, of the sixteenth, seventeenth and early eighteenth centuries are becoming increasingly rare and expensive, and many of them in a few years' time will be unobtainable. A specialised library of the size of that of the Council for Psychical Investigation is, therefore, of great importance for the psychologist and the social historian. In looking through any extensive range of books such as this, it is significant to note how slow has been the growth in appreciation of the nature of evidence when any element of the supernatural has been implicated in an investigation. Although early works, such as Lavater's "Ghostes and Spirites Walking by nyghte . . ." (1572) and Scot's "The Discoverie of Witchcraft" are thoroughly sceptical, it was not until 1668, in the work of the Rev. Joseph Glanville, fellow of the Royal Society and virtually the father of psychical research, that anything in the nature of a systematic setting out of evidence was attempted.

THE recent haunting at Saragossa, in which voices in a chimney have been explained as due to the "unconscious ventriloquism" of a serving maid—an explanation almost as mysterious as the phenomena it explains—adds interest to the accounts in this

exhibition of remarkable manifestations associated with the youth of both sexes from time to time. Eventually they have, as a rule, been attributed to imposture. Among the best known is the Cock Lane Ghost in the middle of the eighteenth century, which inspired one of Andrew Lang's more intellectually agile efforts and is represented in the exhibition by an anonymous pamphlet attributed to Oliver Goldsmith. Another case, equally famous, if more materialistic in its supposed manifestation, was that of Mary Toft (1726) who gave birth to 27 rabbits, but failed to be equally prolific when removed from Guildford to Leicester Fields. In tracing back the history of the investigation of spirits, and of trials for witchcraft, it is remarkable what degree of credence was given to the evidence of juvenile neuropaths, and how frequently it was accepted as adequate, often without corroboration, to ensure condemnation of the accused to prison and death, while at the close of the sixteenth century the case of one Somers discussed in "A Discovery of the Fraudulent Practices of John Darrel . . ." by Samuel Harsnett, an eminent divine and later Archbishop of York, was near to causing a schism in the Church.

### Exhibition of Antiquities from Colchester

A SPECIAL exhibition of antiquities from Colchester opened at the British Museum on December 10. The objects exhibited illustrate the results of the five years' exploration carried out on the British and Roman site at Colchester by the Colchester Excavation Committee, which was formed in 1930 by the British Museum and the Essex and Colchester Museum jointly. The exhibits, which consist of objects obtained by excavation, and plans, drawings and photographs, while giving a general view of the results, serve particularly to illustrate three aspects of the information which five years' work has made it possible to piece together. The first of these is the history of the site, beginning with its first foundation as a British city, then in its period of greatest prosperity under Cunobelinus (A.D. 5), its conquest at the time of the invasion of Claudius (A.D. 43), and its eclipse on the rise of the Roman city seven years later. Apparently the diminished British city shared the fate of the Roman city when the latter was burned by Boudicca in A.D. 61. The photographs of the structural remains discovered and their plans, as well as the series of coins and material remains, are an index of the vicissitudes of the site. The second aspect is the character of native culture at Camulodunum; and the third, the effect of the impact of Roman culture on that of the native. To some, this last will appeal as of the greatest interest of all. Many new facts, indeed, have been brought to light at Colchester, not the least important being the data bearing upon the manufacture of Romano-British pottery. The remarkable discovery of the now famous kiln demonstrated that not only did the Romano-British potters make jugs, mortars, etc. in buff ware, slip coated fabric, castor ware, etc., but they also made the well-known Samian or 'terra sigillata' of which the manufacture had previously been thought to be confined to Gaul.

### Archæological Investigations in Ireland

DR. O'NEILL HENCKEN, director of the Harvard Archæological Mission to Ireland, before leaving for a brief vacation in America, has given an account of the results achieved in the recently completed third year of the Mission's work, which appears in the *Observer* of December 9. Excavations at Cushenden, Co. Antrim, would seem to have confirmed fully the view of the importance of this site for the elucidation of the origin and affinities of the stone age industries of north-east Ireland, which is held by Mr. C. Blake Whelan, with whom the Mission has been in co-operation. Mr. Whelan has recently pointed out the probability that further systematic investigation of stone age sites in this area would provide evidence of stratification, which is lacking for certain of the comparable European industries of the mesolithic and earlier phases of the neolithic ages (see NATURE, Nov. 4, p. 702). From Dr. Hencken's statement, it now seems that this evidence is likely to be forthcoming from Cushenden, when certain comparative studies now in progress have been completed. He states that all the phases of the Irish stone age have been found at Cushenden in conditions, geological and other, which should provide the necessary data for the discussion of the origin of these cultures and their affinities with comparable material from sites in Britain and on the Continent.

DR. HENCKEN also referred to the Mission's investigations on the crannog site of Lagore, Co. Meath, known from the annals to have been the residence of Irish kings in the eighth, ninth and tenth centuries. The excavations have shown that the site was occupied from much earlier times and have brought to light a wealth of material illustrating Irish culture in earlier centuries. The crannog is 150 ft. in diameter and 11 ft. thick. It was surrounded by an oaken palisade. The lake in which it stood has now disappeared. The inhabitants were pastoralists, but practised occasional hunting. Few, if any, traces were found of agricultural activity. Ornaments of bone and objects of leather, predominating in number, bear this out. Other materials in use were bronze, iron, glass (beads), enamel, wood, stone and pottery. The Mission has received generous assistance from the Irish Government.

### Medical Uses of Radium

A REPORT bearing the above title has been issued by the Medical Research Council summarising the results of research work during 1933 in the treatment of cancer and other conditions (Spec. Rep. Series, No. 197. H.M. Stationery Office. 9*d*. net). The radium is lent by the Council to selected centres throughout Great Britain, and these furnish reports to the Radiology Committee. In cancer of the mouth, radium has proved a successful agent in the treatment of primary growths of the tongue, but when the glands are involved they are much less amenable.

With breast cancer, operation is generally successful in early cases, but when the axilla is involved, much less so. For the latter, radium therapy has been extensively tried with questionable success, and X-rays are probably a more suitable agent. In uterine cancer, frankly operable cases are treated as successfully by radium as by surgery, but with a smaller operation mortality, and surgically inoperable cases treated by radiation yield a by no means negligible percentage of clinical cures. Certain non-malignant conditions also respond well to radium treatment, for example, uterine hæmorrhage. Several important experimental researches are also included in the report.

IT is estimated that the total quantity of radium available for treatment in Great Britain is now about 70 gm. Of this amount, the Radium Commission controls 23 gm., which includes 20 gm. placed at its disposal by the Radium Trust, and three 1 gm. units, the property of the King Edward's Hospital Fund (Fifth Annual Reports of the National Radium Trust and Radium Commission 1933–1934. H.M. Stationery Office. 9*d*. net). The radium is distributed for use for experimental work and treatment between the Medical Research Council and the National Physical Laboratory, certain London hospitals and institutions, and thirteen national radium centres and five regional radium centres. In addition, allocations have been made by certain organisations, such as the British Empire Cancer Campaign, and a considerable amount of radium is privately owned.

### National Medical Statistics

THE Registrar-General's Statistical Review of England and Wales for the Year 1933 (Tables, Part 1: Medical), pp. iv+406, has recently been published (London: H.M. Stationery Office. 6*s*. net). It appears that the number of births registered in 1933 was 580,413, giving a rate of 14·4 per 1,000 persons living. This rate is 0·9 below that for 1932, and constitutes a new low record. The death-rate was 12·3 per 1,000 persons living, 0·3 above the rate for 1932 (the same as that for 1931) but 0·9 above that for 1930. The deaths of children under one year of age numbered 64 per 1,000 live births against 65 in 1932, 66 in 1931 and 60 in 1930. Cancer showed a death-rate of 1,526 per million persons living against 1,510 in 1932. If, however, allowance is made for differences in the age constitution of the population, the comparative mortality from cancer shows a slight decrease. Tuberculosis again furnished a new low record of 824 per million living. Puerperal sepsis caused the deaths of 1·75 women per 1,000 live and still births, 0·20 more than the rate for 1932 but 0·09 less than 1930. The death rate from suicide was 140 per million persons living, a decrease of 3 per million on the record high rate of 1932. A slow increase in this rate had been continuous for a number of years. Road accidents due to mechanical vehicles were responsible for 5,934 deaths. The figures for the last five years were 5,196, 5,752, 6,342, 5,892 and 5,671 respectively.

### Exhibition of Microscopes

THE second annual exhibition of microscopes and appliances, conducted by Messrs. W. Watson and Sons, Ltd., 313 High Holborn, London, W.C., which has been open all this week at the Central Hall, Westminster, attracted numerous visitors. A number of mounted specimens were shown on a series of microscopes ranged round the Hall, comprising diatoms, pollens, histological and pathological specimens, and crystals with polarised light. Members of the Quekett Microscopical Club arranged an interesting exhibit of living pond-life, including some beautiful specimens of *Volvox* and *Vorticella*. The use and value of the microscope in industry were demonstrated by exhibits illustrating the differences in microscopic structure of various qualities of leather, the size of sugar crystals, cocoa particles and entangled air bubbles as influencing the quality of sweets in confectionery, and the microscopic flora in cheese and in vinegar fermentation. A side-show of considerable interest was a demonstration of the making of the glass discs and their shaping, grinding and polishing so as to form the constituent lenses for microscope objectives. Other exhibits illustrated the detection of forgery and of crime weapons, and formed the subjects of two of the lantern lectures, by Mr. T. J. Ward and Major G. Burrard respectively, which have been a feature of the exhibition. Other lantern lectures included "A Naturalist on the Amazon" (Mr. Robins), "An Amateur among the Stars" (Mr. Offord), and "How Lenses are Made" (Mr. Watson Baker), together with several cinematograph displays by the Kodak Company.

### Sound and Noise

A RESEARCH and Development Lecture on "Sound and Noise" was given at the Royal Institution on December 12, under the auspices of the Institution and the British Science Guild, by Dr. G. W. C. Kaye, Superintendent of the Physics Department at the National Physical Laboratory. Mr. Hore Belisha, the Minister of Transport, was in the chair. Man has developed very many and ingenious ways of making sounds and noises. In some everyday events the noise is only a small by-product; for example, only about a thousandth part of the energy of a dropped weight or of a hand-clap appears in the form of noise. This figure was increased to a few per cent in the case of motor horns and loud speakers, and even up to 30 per cent or more for the loud speakers used for talking pictures. By comparison with many sounds, the human voice is very weak, and even during shouting the output was only about 0·001 watt. Suitably equipped, an orchestra of 75 has a normal acoustic output of about 0·5 watt, which in strident passages may be increased 100-fold—quite enough, if it could be so applied, to light an average electric lamp.

FOR the purposes of the measurement of the loudness of noise, a reference standard of sound has been chosen, which consists of a pure note of a frequency of 1,000 cycles per second. The adjustable

intensity of the standard note is measured on a scale of decibels above an arbitrary zero near the threshold of hearing; the corresponding loudness is then expressed on a numerically identical scale of phons. The various subjective noise meters on the market determine the equivalent loudness of noises in phons by matching them by ear against the standard note. The objective meters, on the other hand, depend on the physical measurement of the intensity by a microphone; they can, however, be made to stimulate the ear and so compare the loudnesses of similar noises. The new acoustics laboratory at the National Physical Laboratory has greatly facilitated investigatory work on the steps required to reduce sources of noise, on the noise proofing of walls and on the noise absorption of building and other materials. The last line of defence against noise in a building is the use of surface absorbents. Ordinary hard plaster is a better reflector of sound than a mirror is of light, so that in modern rooms designedly free from curtains, upholstery and carpets, the noise level can become uncomfortably high unless one of the commercially available acoustic absorbents is applied to the walls or ceilings.

### Experimental Hand-Rearing of Game Birds

ORNITHOLOGISTS and students of game birds have become increasingly interested in experiments in hand-rearing and introducing game birds to new areas, and what is believed to be the first ptarmigan (*Lagopus leucurus*) to hatch in captivity was from one of eighteen eggs collected by Dr. A. A. Allen, of the Department of Ornithology of Cornell University, near Churchill, Hudson Bay, and put under bantams at Ithaca (*Scientific American*, Nov. 1934). Science Service, of Washington, D.C., reports that a second batch of twenty ptarmigan eggs has been obtained from Canada and put under bantams, though several eggs have been broken by the foster mothers. During the present year, the first introduction, and hatching, of English pheasants (*Phasianus colchicus*) in Uganda was accomplished by the Agricultural Department at Kamala (T. W. Chorley, *Field*, Aug. 4, 1934). The eggs were obtained by Mr. T. W. Chorley, of the Agricultural Department in Uganda, from the Silverdale Game Farm, Lancashire, and arrived by air mail on May 3. Next day they were put under two native fowls, and three chicks hatched on May 27, and the remainder on May 28, 85 per cent of the imported pheasant eggs hatching. Unfortunately, two heavy storms broke out in the first three weeks, and several birds died, but the remainder did well.

### Electricity on Board Ship

THE paper read by C. W. Saunders, H. W. Wilson and Dr. R. G. Jakeman to the Institution of Electrical Engineers on November 22 on the generation, distribution and use of electricity on board ship is a timely one. Although electricity was used in the British Navy for various purposes so far back as 1874, it is only since the advent of the Diesel engine that it has been largely used. To-day, almost all auxiliary machinery—from the windlass in the bows, through the engine room and hull, to the steering gear in the stern—is electrically operated in important ships. In a 20,000 ton turbo-electric passenger liner, the propelling machinery, usually two turbo alternators, would be about 20,000 horse power and there would be usually four motors to which they send the power. In addition, there would be four main generators each of a 1,000 h.p. The steering gear requires 84 h.p., the capstan machines 536 h.p. and the boat davits 120 h.p. For the fans 500 h.p. is required and for the refrigeration 290 h.p. Compared with these numbers, the 31·5 h.p. required for the passenger lifts seems small. A modern liner is really a large floating hotel, and when at sea the travelling public demands a standard of comfort as high as that obtainable on the best hotels ashore. Consequently the most modern types of lighting, heating and cooking equipment are installed. The galley alone at times of maximum load may require 900 h.p. In the *Queen of Bermuda*, for example, there is one 450-line telephone board, 250 electric signs, 2,250 bell pushes, 400 electric radiators, 650 electric fans for cabins, 410 miles of conductors in cables and wires and 20,000 electric lamps. For very large ships it is generally agreed that turbo-electric drive is the most suitable at the present time.

### De la Beche's "Researches in Theoretical Geology"

PUBLISHED in 1834, unpretentious in size and style (12mo.), De la Beche's work was especially welcome to the younger geologists of the time as a philosophical treatise, comprehensive and helpful in design. This little volume had an interesting preface explaining the author's position. It ran as follows:—"Although the theory of central heat and the former igneous fluidity of our planet have been much dwelt upon in the following pages, the author trusts that he will not be considered so attached to these views as not to be ready to reject them and embrace others which may afford a better explanation of an equal number of unobserved facts. . . . It can only be amid a thousand errors, and by a determination to abandon our preconceived opinions, when shown to be untenable, not by pertinaciously adhering to them . . . that we can approximate towards the truth. By strictly advocating a particular theory, prominently displaying those facts only which may appear to afford it support, we are in perpetual danger of deceiving ourselves and others." Finally—"We may conclude that whatever changes our planet may suffer, either from external or internal causes, and the necessary conditions exist, life will be created to suit those conditions; even after man, and the terrestrial animals and plants contemporaneous with him, may have ceased to live on the surface of the earth."

### Proceedings of the Fifth Pacific Science Congress

IT is hoped to publish very shortly the complete *Proceedings* of the Fifth Pacific Science Congress which was held at Victoria and Vancouver, Canada, in June 1933. The publication will be in five volumes:

(1) general and Congress symposia; (2) astronomy, geodesy and geography, geology and mineral resources; (3) meteorology and terrestrial magnetism, oceanography, radio, seismology and volcanology; (4) agriculture, anthropology, animal diseases and botany; (5) entomology, fisheries, forestry and zoology. The *Proceedings* will be published by the University of Toronto Press, Toronto, Ont., Canada, price 20 dollars.

*Journal of Applied Mechanics*

THE Applied Mechanics Division of the American Society of Mechanical Engineers will publish a *Journal of Applied Mechanics* beginning on March 1935. The technical editor will be J. M. Lessells, Swarthmore, Pa., U.S.A., who will have the assistance of several distinguished authorities on applied mechanics. The *Journal* will appear four times each year in issues containing about eighty pages each. It will consist of original papers in general mechanics, elasticity, hydrodynamics, aerodynamics, strength of materials and thermodynamics, similar to those published during the last few years in the *Transactions* of the Applied Mechanics Division of the Society. The price will be five dollars for non-members of the Society for annual subscription, to be sent to A.S.M.E., Applied Mechanics Journal Fund, 29 West 39th Street, New York, N.Y., U.S.A.

### The Physical Society's Exhibition

THE twenty-fifth annual exhibition of scientific instruments and apparatus, arranged by the Physical Society, will be held on January 1–3 at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, S.W.7. The leading manufacturers of scientific instruments will be exhibiting their latest products in the Trade Section. The Research and Experimental Section will contain contributions from most of the important research laboratories in Great Britain, and there will be a special sub-section devoted to experiments of educational interest. In addition, the work submitted for the craftsmanship competition by apprentices and learners will be on view. Discourses will be delivered each day at 8 p.m. as follows: January 1, Dr. B. Wheeler Robinson, "The Architecture of Molecules"; January 2, Dr. C. V. Drysdale, "The Problem of Ether Drift"; January 3, Dr. H. Spencer Jones, M.A., "Giant Telescopes". Members of institutions and scientific societies may obtain tickets from their secretaries; tickets may also be obtained direct from the Exhibition Secretary, 1, Lowther Gardens, Exhibition Road, S.W.7. No tickets will be required on January 3.

### Announcements

MR. MERVYN O'GORMAN will read a paper entitled "Bringing Science into the Road Traffic Problem" before the British Science Guild at the Royal Society of Arts, John Street, Adelphi, London, W.C.2, on December 19, at 5 p.m. The paper will be followed by a discussion.

THE following appointments have recently been made by the Secretary of State for the Colonies: C. B. Gibbins, to be agricultural assistant, Coffee Experimental Station, Moshi, Tanganyika; S. G. Wilson, to be veterinary officer, Nyasaland; A. C. Shill, marketing officer, fruit and vegetable trades of the Leeward and Windward Islands, to be adviser in agricultural marketing and controller of agricultural exports, Malta; T. H. C. Taylor, late entomologist, Coconut Committee, Fiji, to be assistant entomologist, Agricultural Department, Uganda.

THE Royal Academy Exhibition of British Art in Industry will be opened on January 5 and will close early in March. In connexion with the Exhibition, a panel of lecturers has been organised who are prepared to visit schools, works, etc., to lecture on cognate subjects. Further information can be obtained from the Secretary, Royal Academy of Arts, Piccadilly, London, W.1.

IN the list of British representatives present at the opening of the Maison de Chimie in Paris (NATURE, Dec. 8, p. 868) it should have been stated that Mr. Edwin Thompson was present in his capacity as president of the Society of Chemical Industry.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in botany in the University of Western Australia—The Agent-General for Western Australia, Savoy House, Strand, London (Dec. 18). An assistant in the M.B. classes and in dental metallurgy at Guy's Hospital Medical School—Prof. C. S. Gibson, Guy's Hospital Medical School, London, S.E.1 (Dec. 19). A technical assistant in the War Department Establishment—The Superintendent, Signals Experimental Establishment, Woolwich Common, S.E.18 (Dec. 19). A teacher of metallurgy at the Municipal Technical College, Coventry—The Director of Education, Council House, Coventry (Dec. 21). Two agricultural advisory officers to the Norfolk County Council—The Clerk, The Shirehouse, Norwich (Dec. 22). A lecturer in electrical engineering at West Ham Municipal College, Romford Road, E.15—The Principal (Dec. 31). A demonstrator in chemistry at King's College, Strand, London, W.C.2—The Secretary (Jan. 1). A professor of electrical engineering at the College of Engineering, Guindy, Madras—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Jan. 4). A University lecturer in zoology at the University of Cambridge—F. T. Brooks, Botany School, Cambridge (Jan. 7). A director of forestry in the Irish Free State—The Secretary, Irish Land Commission (Forestry), 24, Upper Merrion Street, Dublin (Jan. 31). An investigator for metallurgical research at Cambridge—Prof. R. S. Hutton, University Metallurgy Laboratories, Pembroke Street, Cambridge. A professor of hydraulic engineering and a professor of mechanical engineering at the National Chekiang University, Hangchow—Universities China Committee, 91, Gower Street, London, W.C.1. A junior investigator at the British Non-Ferrous Metals Research Association—The Secretary, B.N.F.M.R.A., Regnart Buildings, Euston Street, N.W.1.

## Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 938.

### A New Potato Epidemic in Great Britain

EARLY blight (*Alternaria solani*) of the potato has been observed in Great Britain in the field only but very rarely, and its attacks have not been known hitherto to assume epidemic proportions in Great Britain. In the autumn of 1932 several sporadic cases were noted in the experimental plots at Cambridge, whilst somewhat earlier a few of our plants in the glasshouse had been thought to be suffering from the same disease. At that time examination of the lesions had failed to demonstrate the distinctive spores. In 1933, the disease was considerably more common at Cambridge, and in the autumn of that year, Dr. Dillon Weston very kindly examined specimens and recovered from them an *Alternaria* in pure culture. Sub-cultures were submitted to Prof. Westerdijk of Baarn and to Mr. Wiltshire of the Imperial Mycological Institute, both of whom identified the species as *A. solani*.

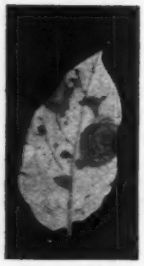

FIG. 1. Leaflet showing the rounded lesions and the concentric rings—the fusion of individual flecks is commencing. —Photo by infra-red light.

FIG. 2. An entire leaf of a Kerr's Pink plant representing the average condition of the disease in this variety in north-west Scotland towards the end of September 1934.

During 1934 we have succeeded in infecting a large number of seedlings, as well as several adult plants of established varieties both in the glasshouse and the field, and have had no difficulty in finding the spores on the lesions.

One of us had occasion to spend the month of September examining potato crops in the Outer Hebrides, the north-west coastlands, and in the great potato-growing areas of Ross, Cromarty and Aberdeen, and found that the disease—often in an advanced stage—was present throughout the whole area on every plant examined of the widely grown variety Kerr's Pink. Plants of the variety Edzell Blue were less heavily infected, whilst those of the variety Golden Wonder seemed to have escaped attack. A similarly widespread and intensive field infection was found in the late autumn in Cambridge on the varieties Majestic and King Edward.

In the United States, tuber damage is a common feature of the disease, but we have no evidence so far that the tubers have been affected in the field in Great Britain. It may be that the epidemic spread is correlated with the occurrence of the last two abnormally dry seasons, but against this it must be remembered that we first observed the disease in the field in the summer of 1932.

Apart from loss due to direct damage to the tuber, it is almost certain that a disease which destroys about 25 per cent of the green leaf area of the plant must cause a sensible reduction in crop, if only as a result of the loss of photosynthetic tissue.

It is obvious that we are now confronted in Great Britain with early blight in an epidemic form. This disease has long been a serious source of loss in various parts of the Continent, including Holland, and is regarded as one of the major potato diseases in the United States, where it is responsible in some years for a loss due to tuber infection in the neighbourhood of 25 per cent of the crop. On the Continent, in the United States, India and South Africa, the ravages of this disease have been held in check fairly satisfactorily by use of the Bordeaux spray or copper-lime dust.

REDCLIFFE N. SALAMAN.
CECILIA O'CONNOR.
Potato Virus Research Station,
Cambridge.

### Longevity of Seeds

THE question of the longevity of buried seeds is always recurring, as witness the recent revival of the fable of 'mummy wheat'. There is abundant evidence that the embryo of the wheat grain perishes relatively soon, in ten years or less under ordinary conditions. Respiration goes on until the substance of the embryo is burnt away; extreme desiccation may prolong the process. Other seeds, however, do retain their vitality for much longer periods when dry, and when buried in earth germination may be indefinitely delayed. Possibly the tension of carbon dioxide in the soil gases slows down the respiration process; again, we have found that humus, particularly of deep-seated peat, contains substances inhibiting germination, even when the conditions of moisture, aeration and temperature are optimum.

This raises the fundamental question of whether the life of an organism can be suspended and pass into a static condition, to be resumed when the environment becomes favourable again. So far as our experimental knowledge goes, seeds are always respiring, considerably at first when they are drying off after ripening, but then more slowly, the machine just 'ticking over' as long as life remains.

If the essence of life resides in change, can there be a stop and a later resumption? On the basis of some continuing change, however minute, being necessary,

how are we to account for the long dormant life of some organisms that possess a very small reserve of respirable material, as for example the spores of bacteria which in the dry state have a very long recorded life? Some refined experiment seems to be needed to try whether in such cases respiration, however infinitesimal, is not still going on.

This is not the only unsolved question that the dormancy of seeds presents. Every farmer and gardener is familiar with the growth of certain weeds, notably charlock, which follows the ploughing up of land which may have been in grass twenty or thirty years. But why in an ordinary arable field, subject to charlock, do we get a rush of growth in one year and few or no seedlings in another? Why do other rare plants suddenly spring up in unexpected places? In Dr. Brenchley's experiments on the germination of seeds contained in soils taken at different depths from the old Rothamsted plots, the soil samples are exposed to optimum conditions of aeration, moisture and temperature, but years elapse before all the seeds germinate.

In the past abnormal season many unexpected 'weeds' have appeared in the John Innes gardens. Some are comparatively uncommon plants, that as far as is known have never been grown here; for example, *Datura sp.*, *Ambrosia artemisiaefolia*, *Physalis edulis*, etc. It may be supposed the seed had been introduced in manure, but considering the rarity of the plants, that only shifts the locality of the problem. One piece of land here, after it had been cleared from sweet peas, has covered itself with *Nicotiana* seedlings. Nine years earlier the plot had carried *Nicotiana*, but in the intervening period not a seedling had been seen. We know something of the effects of 'vernalisation' and of chilling in stimulating the germination of certain seeds which may otherwise refuse to start, but this dormancy of buried seeds still offers problems for experiment.

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## Kinetics of Photosynthesis

I AM grateful to Emerson and Green[1] for directing attention to the fact that the equation expressing the velocity of photosynthesis during the photostationary state[2] was incorrect because it indicated that the temperature coefficient is a function of the external $CO_2$ concentration. Their alternative formula is open to the same criticism, since it indicates that the temperature coefficient increases with decrease in $CO_2$ concentration. The error is due to an incomplete definition of the conditions which govern the photostationary state.

There are three processes involved; namely, the primary light reaction in which the chlorophyll in its complex with $CO_2$ undergoes a change, the Blackman reaction in which this changed chlorophyll is restored to its original state, and the formation of the complex of chlorophyll with $CO_2$. If the velocities of these three processes be equated to give the expression for the photostationary state, the resulting expression indicates that the rate of photosynthesis in flashing light is independent of the external $CO_2$ concentration, which is known not to be the case. If, however, the assumption be made that the rate of formation of the complex with $CO_2$ is very fast in the case of the chlorophyll formed in the Blackman reaction, and that the establishment of the equilibrium between ordinary chlorophyll and $CO_2$ is slow, the equation for the photostationary state is simplified to

$$y = k_1 I(bA - x) = k_2 x e^{-Q/RT}$$

whence

$$\log \frac{y}{K - y} = \log \frac{k_2}{k_1 I} - \frac{Q'}{T},$$

where $A$ is the total concentration of chlorophyll in the irradiated surface, $b$ is the fraction which exists as the complex, $K = k_1 IbA$ and $Q' = Q/2{\cdot}303R$.

These equations indicate that the temperature coefficient is independent of the $CO_2$ concentration and that the rate in flashing light is a direct function of the $CO_2$ concentration, since $b$ is a function of that concentration.

Emerson and Green's equation for the photostationary state

$$y = k_1 Ix = k_2(a - x)Pe^{-Q/RT}$$

appears to be incorrect. Since $k_2(a - x)Pe^{-Q/RT}$ is the velocity of the dark or Blackman reaction, $x$ will be a maximum after a period of darkness. It follows that $k_1 Ix$ will be a maximum the moment irradiation is commenced and will decrease with time until the photostationary state has been established. The above equation, therefore, cannot express the photostationary state.

It is not possible here to discuss the chemistry of the photosynthetic process, but it may be stated that it is not intended to represent the Blackman reaction as being uni-molecular. It is bi-molecular, but since the concentration of the second reactant is assumed to be large and sensibly constant, it is included in the constant $k_2$. A complete account will be given in a separate communication.

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Nov. 20.

[1] NATURE, 134, 289, August 25, 1934.
[2] NATURE, 133, 414, March 17, 1934.

## Inhibitors of Catalase Reaction

IT is well known that the activity of catalase is greatly inhibited by very small concentrations of potassium cyanide, hydrogen sulphide and especially hydroxylamine. To these reagents we can now add sodium azide ($NaN_3$) which also acts as a strong inhibitor of catalase.

In a recently published note, Sevag and Maiweg[1] have announced the discovery of a new type of catalase poison belonging to the group of oximes. They have found, however, that these compounds when used freshly prepared have no poisoning properties. The inhibitory property of the oxime solution is manifested only after acidifying it with dilute hydrochloric acid, warming for twenty minutes and neutralising with dilute soda. It is interesting to note that this inhibitory property was found by these authors to be proportional to the strength of acid used in their manipulation.

Following the technique described by Sevag and Maiweg, 0·232 gm. of dimethylglyoxime ($CH_3C(NOH).C(NOH).CH_3$) was dissolved in 100 c.c. of water, containing 10 c.c. normal hydrochloric acid, warmed for 20 minutes on a water bath and neutralised with normal caustic soda.

The solution thus prepared, contrary to the

statement made by these authors, was found to contain a large concentration of hydroxylamine. This solution, like hydroxylamine and unlike oxime, on addition of sodium nitroprusside and a little caustic soda, turns red on heating. Like hydroxylamine it oxidises hæmoglobin to methæmoglobin. It precipitates cuprous oxide from an alkaline solution of copper sulphate, and the titration of this solution with Fehling solution reveals the presence of about 87 mgm. of free hydroxylamine. We find therefore that about 66 per cent oxime was decomposed, liberating a corresponding amount of hydroxylamine.

On testing this solution with nickel it was found to contain only 29 per cent of undecomposed dimethylglyoxime, which conforms fairly well with the previous estimation of the free hydroxylamine.

These results show that 0·018 *M* solution of oxime treated by the method of Sevag and Maiweg gives approximately 0·024 *M* solution of hydroxylamine. In other words, the molar concentration of hydroxylamine (a well-known catalase inhibitor) in Sevag and Maiweg's solution, at the end of their manipulation, was higher than the initial concentration of the oxime. It is not surprising, therefore, that their solution had such a powerful inhibitory action on catalase.

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[1] Sevag, M. G., and Maiweg, Lore, *Naturwissenschaften*, **22**, 561; 1934.

## Passage of Very Fast Protons through Matter

It is now generally assumed in nuclear theories[1] that the interaction between a neutron and a proton is of the form

$$-J(r)\,S \qquad (1)$$

where $J(r)$ is some function of the distance $r$ between them, and $S$ is the operator which interchanges the space co-ordinates but not the spin of the two particles. Such an interaction has some important consequences in the passage of very fast protons through matter.

We consider a collision in which the neutron is initially at rest, and the proton moving with a large momentum such that the wave-length is small compared to the effective radius of the interaction $J(r)$. Then, as Wick[2] has pointed out, with an exchange interaction of the type (1), most of the *neutrons* are thrown in the forward direction. (With a non-exchange interaction, most of the protons would be scattered in the forward direction.) To calculate the magnitude of the collision cross section we must make some assumption about the form of $J(r)$, of which we know very little. Assuming $J(r)$ to be of the form

$$J(r) = a\,e^{-br} \qquad (2)$$

the effective cross section, calculated by the Born approximation, for the scattering of the neutron in the solid angle $d\omega$ making an angle $\theta$ with the original direction of the proton is

$$\frac{256\pi^4}{h^4}\,\frac{a^2b^2}{\left\{b^2+\frac{4\pi^2}{h^2}\left|\underline{p}_1-\underline{p}_0\right|^2\right\}^4}\times \frac{p_1^2\,E_0\,E_1}{p_0\left|p_1+\frac{E_1}{E_0+Mc^2-E_1}\,(p_1-p_0\cos\theta)\right|^2c^4}\,d\omega \qquad (3)$$

where $p_0 = Mv/\sqrt{(1-v^2/c^2)}$ is the initial momentum of the proton, $v$ its velocity, $M$ the mass of the proton or neutron assumed equal, and $E_0 = c\sqrt{(p_0^2 + M^2c^2)}$ the initial energy of the proton. $E_1$, $p_1$ are the energy and momentum of the neutron given by the conservation of energy and momentum for a particle scattered at an angle $\theta$. The effective cross section for the scattering of the neutron in any angle less than $\theta$ is

$$q(\theta)=\frac{64\pi^3}{3}\,\frac{E_0^2}{c^2p_0^2}\cdot\frac{a^2b^2}{h^2c^2}\left[\frac{1}{b^4}-\frac{1}{\left\{b^2+\left(\frac{2\pi p_0}{h}\right)^2\sin^2\theta\right\}^3}\right] \qquad (4)$$

where we have neglected terms of the order $(hb/2\pi Mc)^2$. When $2\pi p_0/h \gg b$, (3) has a very strong maximum in the forward direction, and in this case the mean angle $\bar{\theta}$ at which the neutrons are ejected is

$$\bar{\theta} = \frac{1}{\sqrt{2}}\cdot\frac{hb}{2\pi p_0}, \qquad (5)$$

and the neutron has on the average an energy less than the original energy of the proton by an amount $\delta$, where

$$\delta = \frac{1}{16\pi^2}\cdot\frac{h^2b^2}{M}. \qquad (6)$$

Taking $a = 1{\cdot}4 \times 10^{-4}$ erg, $b = 6{\cdot}8 \times 10^{12}$ cm.$^{-1}$, being the values determined by Wick[2] from the stability of oxygen, the total cross section for an encounter $q$, got by neglecting the last term in square brackets in (4), is $0{\cdot}16 \times 10^{-24}$ cm.$^2$, $\bar{\theta} = 1{\cdot}1°$, and $\delta \approx 0{\cdot}47 \times 10^9$ e.v., for a proton with $E_0 = 5 \times 10^9$ e.v. $\approx 5{\cdot}4\ Mc^2$, such as might possibly occur in cosmic radiation.

Thus, such a proton in its passage through matter will go on until it collides with a neutron and gives nearly all its energy to the neutron. The neutron will travel until it collides with a proton in the material as given by (4), (5), (6), and the proton which is thus ejected will have very nearly the same energy as the original proton, and travel in very nearly the same direction. Further, for protons of such high energies we should expect to be able to treat the neutrons in nuclei as free, so that, using the cross section given above, the mean 'range' of a proton in lead is about 1·5 cm., and that of the neutron about 2·3 cm., as the lead nucleus contains 82 protons and about 125 neutrons. Therefore in going through a metre of lead there will be roughly twenty-five changes from proton to neutron and back, and the total energy loss due to ionisation of the emerging proton will be about half that to be expected theoretically since more than half the distance will be travelled by neutrons.

We may remark, that with the values of $a$ and $b$ assumed above, an accurate calculation[3] of the cross section for the collision of neutrons of energy roughly $3{\cdot}8 \times 10^8$ e.v. with protons gives a result which is nearly four times larger than the cross section found by Chadwick. Our results may therefore be too large by a factor four.

The above expressions are further inaccurate inasmuch as (*a*) there is no relativistic wave equation for the proton, and (*b*) the interaction energy (1) can be represented by a potential $J(r)$ probably only in non-relativistic approximation. One might hope that the correct relativistic treatment would reduce the total cross section given above.

Gonville and Caius College, Cambridge. Nov. 10.

H. J. Bhabha.

[1] W. Heisenberg, *Z. Phys.*, **80**, 587; 1933. E. Majorana, *Z. Phys.*, **82**, 137; 1933.
[2] G. C. Wick, *Z. Phys.*, **84**, 799; 1933.
[3] G. C. Wick, *Nuovo Cimento*, **11**, 235; 1934.

## An Equation for the Kinetics of Activated Adsorption

FOR an understanding of the nature of so-called activated adsorption, the kinetic characteristics of these types of processes are of the greatest importance. From the first conception of Taylor one might expect to find kinetic equations, based on the molecular kinetic theory of Langmuir, taking into account the low condensation coefficient increasing with the temperature. But, as I have shown in a lecture on activated adsorption given in Moscow (1932) at the IX Physical-Chemical Conference[1], of all cases of activated adsorption known at this time, not one obeys these equations. The well-known diffusion kinetics equations also cannot be applied to these systems.

Somewhat later, in our laboratory, J. Zeldowitsh showed that for the chemosorption of carbon monoxide on manganese dioxide, the velocity of the process can be well expressed by the following simple equation:

$$\frac{dq}{dt} = V_0 e^{-\alpha q}; \quad V_0 = be^{-E/RT} \qquad (1)$$

where $q$ is the quantity of gas adsorbed during the time $t$, $\alpha$ and $b$ are constants, characteristic for the given system[2]. On account of the high value of $\alpha$, the velocity of adsorption diminishes several tenfold before saturation is half reached.

At first we did not assign fundamental significance to this empirical equation, but an analysis of the literature has shown that the kinetics of most of the known cases of activated adsorption, differing widely in their chemical nature and temperature range, follow an analogous law. Thus, for example, this equation written in a more convenient form:

$$q = \frac{1}{\alpha} \ln (t + t_0) + C \qquad (2)$$

where $t_0 = \frac{1}{\alpha . V_0}$ and $C = \frac{1}{\alpha} \ln \alpha V_0$

is satisfied by the data of Emett and Brunauer[3] on the sorption of nitrogen in iron, those of Benton and Drake[4] for oxygen on silver, those of Taylor and Sickman[5] for hydrogen on zinc oxide, etc.

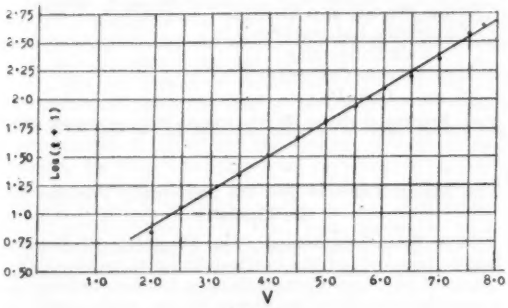


FIG. 1.

It is easy to show that the adsorption of ethylene on nickel in a recent paper of Steacie and Stovel[6] is very well expressed by this equation. The agreement is shown on Fig. 1 which shows the activated sorption as a function of time, for the 142° curve in Fig. 1 of Steacie and Stovel's paper. Thus we may suppose that an equation of type (2) *is a general equation for the kinetics of activated sorption.* It is easy to show that equations (1) and (2) *cannot* be derived from the usual ideas as to the character of activated adsorption, and that they lead to a very peculiar picture of the course of such processes, which at the same time gives an explanation for the appearance of large steric factors (another characteristic of activated adsorption).

We shall return to these equations in a fuller paper to appear soon.

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Oct. 24.

[1] S. Roginsky, *J. Phys. Chem.* (Russ.), **5**, 175; 1934.
[2] S. Roginsky and J. Zeldowitsh, *Acta phisico-chimica*, **1**, 1934 (in print).
[3] Emmet and Brunauer, *J. Amer. Chem. Soc.*, **56**, 35; 1934.
[4] Benton and Drake, *ibid.*, **56**, 255; 1934.
[5] Taylor and Sickman, *ibid.*, **54**, 602; 1932.
[6] Steacie and Stovel, *J. Chem. Phys.*, **2**, 581; 1934.

## Absorption of Light in Gases

CONTINUING an earlier experiment[1], we have measured the absorption of light by cæsium vapour in the presence of helium. We find that the addition of helium greatly reduces the absorption by cæsium, about 3 cm. of helium being sufficient to reduce it to half the value obtained for cæsium in vacuum. Frank[2] and Mrozowski[3] have shown that the continuous molecular absorption of mercury, zinc and cadmium vapours is proportional to $P^\gamma$, where $P$ is the vapour pressure and $\gamma$ is a constant (for one wave-length). For different wave-lengths, $\gamma$ lies between 1 and 2. Thus the absorption increases less rapidly than the molecular concentration. Their results may perhaps be explained if there is a reduction of absorption, due to collisions between atoms and molecules in the vapour, similar to the effect we have found in cæsium and helium.

Other work[4] has shown that the absorption of light by reacting gas mixtures is not equal to that calculated by summing the absorption of the constituents, the absorption being apparently increased.

Thus it is not possible to assume that in general the absorption of a gas is simply proportional to the concentration of the atom or molecule producing the absorption. It would appear probable that many calculations (particularly in photo-chemistry and stellar physics) may need revision in the light of the above results.

In all experiments where a large pressure effect has been found, the absorption has been due to transitions involving one unquantised state. It is known[5] that the magnitude of the line absorption of atoms (where two quantised states are involved) is not greatly affected by the addition of foreign gases. Further experiments on continuous absorption and molecular band absorption are in progress.

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Dec. 3.

[1] *Proc. Roy. Soc.*, A, **143**, 472; 1934.
[2] *Phys. Z. Sowjet Union*, **4**, 637; 1933.
[3] *Z. Phys.*, **91**, 600; 1934.
[4] NATURE, **134**, 848, Dec. 1, 1934.
[5] Fuchtbauer, Joos and Dinkelacker, *Ann. Phys.*, **71**, 204; 1923.

## Gyromagnetic Effect for a Ferromagnetic Substance above its Curie Point

UP to the present, no satisfactory explanation has been given for the magnitudes of the magnetic moment per atom of ferromagnetic substances as deduced from the saturation intensities at low temperatures. Furthermore, these data do not admit of correlation with the magnetic moment per atom (or ion) obtained from susceptibility measurements of the ferromagnetics above the Curie point. Hence it is advisable to measure the gyromagnetic ratio for a ferromagnetic substance above its Curie point in order to find the origin of the paramagnetism in this region.

Experimental difficulties preclude measurements at temperatures above room temperature, and so it is necessary to choose an alloy the critical point of which is in the neighbourhood of 0° C., or lower. A suitable alloy is found in the nickel-copper series, which possesses the additional advantage that the magnetic moment per nickel atom in the paramagnetic state is independent of the concentration in the range of alloys concerned; that is, it is the same as in pure nickel. The experimental difficulties are considerably greater than those encountered in the case of normal paramagnetic substances which I have investigated, being further complicated by hysteresis and permanent magnetic moment as additional sources of error. However, results were obtained on three different alloys (nickel content $\sim 56{\cdot}5$ per cent) the Curie points of which were $-14°$, $-9°$ and $-2°$ C., the mass susceptibilities ranging from 98 to $180 \times 10^{-6}$. The mean result for $g$ is 1·9 with an estimated accuracy of 10 per cent. Thus the $g$ value of 2·0 is within experimental error, indicating that the paramagnetism of the nickel is due to spin alone, as in the case for the ferromagnetic state.

Opportunity was taken to make a systematic test of the contention made by Barnett that my results on the gyromagnetic effect for paramagnetic substances, as well as earlier work on ferromagnetics, are vitiated by unsuspected sources of error peculiar to English physicists[1]. Conditions were particularly favourable to such tests as the disturbing effects are particularly large for the alloys investigated above. In no case, however, was any error detected in the technique previously employed. A full account of the work will appear elsewhere.

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[1] Barnett, *Phys. Z.*, **35**, 203; 1933. For discussion, see also Bates, NATURE, **134**, 50, July 14, 1934.

## Humidity-Resistance Relations in Carbon-Coated Hygroscopic Materials

RECENT notes[1] on paper hygrometry recalled to me some earlier observations by myself on the decrease in electrical resistance with drying of a paper coated with a glue-lampblack mixture, and have led to further experiments with carbon-coated hygroscopic materials. This decrease in resistance is attributed to the closer and more numerous carbon contacts as the paper shrinks.

Data for the paper mentioned above, for 'Cellophane' with indian ink lines, and for human hair coated with indian ink appear in Fig. 1. For the paper and the 'Cellophane', the resistances are the equilibrium values attained in fanned air after standing over either calcium chloride or a saturated solution of potassium chloride (86 per cent relative humidity). The hair was studied only in quiet atmospheres of various humidities provided by salt solutions. The temperatures were those of the room.

Both the paper and the 'Cellophane' were 'conditioned'. They were exposed, alternately, to dry and to moist atmospheres until their resistances approached nearly constant lower values at given humidities. Half a dozen wet-dry cycles were sufficient. The hair was not so conditioned. All data obtained with it appear in Fig. 1.

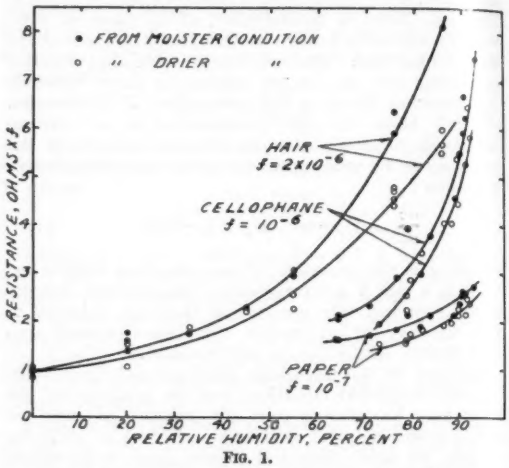


FIG. 1.

In nearly saturated atmospheres, the electrolytic conduction in the paper predominated over the conduction by carbon. As a consequence, its resistance passed through a maximum when the atmosphere changed to or from saturation. Corresponding experiments with 'Cellophane' and hair were not made.

The paper and 'Cellophane' resistors were 20 cm. × 1·25 cm., with ends dipping 1 cm. into mercury wells. The hair resistor consisted of 27 segments in parallel, each 2·5 cm. long. The hair had been boiled in ethyl ether. Resistances were computed from the currents given by a 1·5 volt dry cell.

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[1] K. Mellanby, NATURE, **132**, 66, July 8, 1933. J. Grant, *ibid.*, 677, Oct. 28, 1933. P. H. Prior, *ibid.*, 857, Dec. 2, 1933.

## The Maüle Reaction and the Systematic Position of the Gnetales

IN a book just issued[1], Dr. Hagerup, of Copenhagen, has revived the much-debated question of the origin of the Angiosperms, basing his conclusions on a detailed, comparative study of the organogeny of the floral structures in a series of representative species of the Gnetales, Piperaceæ and Juglandaceæ. From this investigation he derives support for the belief in the close relationship of the Piperaceæ and the Gnetales, the differences between them being, in his view, of minor importance morphologically; so that either the Gnetales should be added to the Angiosperms, as Lignier contended, or the Piperaceæ should be regarded as having arisen directly from

gymnospermic ancestors through the Gnetales, as the author himself maintains.

These conclusions have been based upon observations, admirably extensive, but along organographical lines only, and they have been opposed, in review, on that ground. It is therefore worth while directing attention to supporting evidence from an entirely different side.

The long-neglected Maüle reaction[2] consists in the chlorination of lignin by treatment with potassium permanganate and strong hydrochloric acid (the original procedure) or directly with chlorine water, followed by ammonia, which may be replaced by an alkali or an organic base. The result is a bright red colour of unknown chemical nature which appears to be an indicator, colourless in the acid form and with red salts, with a C = O chromophore group in the molecule.

This reaction was claimed by Maüle as specific for Angiosperm wood, and an extensive test by us in 1932–33, covering forty-three families of Angiosperms, supports this claim, with the outstanding exception that the colour is also given by the wood of all three genera of Gnetales and by them alone among non-Angiosperms, except in the sclerenchyma (not the xylem) of two species of *Stangeria* and possibly also one species of *Podocarpus*, which gives a weak reaction according to Crocker[3].

The Gnetales stand out conspicuously in sharing this distinctively angiospermic element of constitution.

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Nov. 5.

[1] Hagerup, "Zur Abstammung einiger Angiospermen durch Gnetales und Coniferae". Copenhagen, 1934.
[2] Maüle, *Bei. Wiss. Bot.*, **4**, 166; 1901.
[3] Crocker, *Bot. Gaz.*, 95, 168; 1933.

## Traffic Noise

Now that so much is being done in order to find means of reducing street and other noises, it may be worth while considering whether there are not more factors than intensity and character of the noise to be taken into account. It is fairly probable that any noise is more objectionable when it is intermittent; and it is also possible that an intermittent noise with quick rate of change is more objectionable than one in which the rate is slow.

Sir Herbert Maxwell points out in NATURE of November 3 that horse traffic used to be more noisy than the present-day motors; but it certainly caused less annoyance. May not the reason, or one of the reasons, be that changing gear or using a cut-out involves sudden change in noise; and may not the greater speed of modern traffic be a contributing cause of the trouble, in that fast approach of a noisy vehicle results in greater rate of change of noise as heard by anyone at a standstill? The clatter of a two-horse dray rumbling over granite setts was continuous, and became audible gradually to anyone who was not on the move; but the noises created by a motor cycle without silencer, or by a bus changing gear after getting under way involve quick rate of change. I am sure that rate of change must be taken into account in deciding whether a given noise is objectionable or not.

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## Corrections to the Refractive Indices of Quartz in the Infra-Red

IN the region 3–4 $\mu$, the dispersive power of crystalline quartz (ordinary ray) is about four times that of fluorite and thirteen to fourteen times that of rock-salt, but, because of strong absorption beyond 3·6 $\mu$ and also between 2·8 $\mu$ and 3·1 $\mu$, quartz has been neglected as a prism material in this part of the spectrum. The high dispersive power does, nevertheless, more than compensate for the loss due to absorption, and better resolution is obtainable than with fluorite.

When prisms of quartz and fluorite were used in a recent research, it was found that wave-length discrepancies occurred between the results obtained with the two prisms, and these were traceable to the relatively inaccurate data for the refractive indices of quartz. The figures available for quartz in this region are due to Rubens[1], who measured the refractive indices of both quartz and fluorite by the method of coincidences, using a wire grating; later he corrected his results to be in accordance with Paschen's more accurate values for fluorite[2]. Paschen[3] has since given still more accurate data for fluorite, and Rubens' values for quartz are no longer correlated with these. Moreover, the dispersion curve for quartz up to 3 $\mu$ is accurately known[4] and is smooth, while Rubens' curve, in addition to showing two rather abrupt bends, does not join up well with this but intersects it at a small angle at 3 $\mu$.

From the comparison of the results lately obtained with quartz and fluorite prisms, values for the refractive indices of quartz have been estimated for several wave-lengths between 3 $\mu$ and 3·8 $\mu$, and these, when plotted, are found to lie on a smooth continuation of the curve up to 3 $\mu$. These corrected refractive indices of quartz are given in the accompanying table, and should be regarded as provisional values, suitable for adoption until direct determinations of greater accuracy become available, whilst not in any way obviating the need for the latter. The corrections proposed, it will be seen, are of quite appreciable magnitude.

| $\lambda$ | n (Rubens) | n (Corrected) | Difference |
|---|---|---|---|
| 3·03 $\mu$ | 1·4987 | 1·4987 | 0 |
| 3·18 | 1·4944 | 1·4947 | + 0·0003 |
| 3·40 | 1·4879 | 1·4885 | + 0·0006 |
| 3·63 | 1·4799 | 1·4809 | + 0·0010 |
| 3·80 | 1·4740 | 1·4746 | + 0·0006 |
| 3·87 | (1·4715)* | 1·4715 | 0 |

* Interpolated value.

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[1] Rubens, *Ann. Phys.*, **53**, 273; 1894.
[2] Paschen, *Ann. Phys.*, **53**, 325; 1894.
[3] Paschen, *Ann. Phys.*, **4**, 299; 1901. **41**, 670; 1913.
[4] Paschen, *Ann. Phys.*, **35**, 1005; 1911. Carvallo, *C.R.*, **126**, 728; 1898. Coblentz, *Sci. Pap. Bur. Stan.*, **16**, 701; 1920.

## Spectrum of Acrolein

IN connexion with measurements on the photochemical decomposition of acrolein we have measured (Hilger E 315 spectrograph) its ultra-violet absorption spectrum. There are two distinct regions of absorption, one consisting of bands with no overlapping continuum, extending from *c.* 4000 A. to 2800 A.; the other of continuous absorption beginning at

*c.* 2300 A. and extending towards higher frequencies. The first region becomes continuous at pressures above *c.* 60 mm. These results agree essentially with the earlier work of Lüthy[1]. The first region corresponds to absorption by the carbonyl group. Saturated ketones have also been found to give banded absorption below *c.* 2100 A., so that the second region found here might also involve absorption by the carbonyl group. On the other hand, some facts suggest that the continuous absorption is really to be attributed to a primary excitation of the C = C link. In consequence of the conjugated grouping this may be displaced towards the red as compared with that usually found.

The main feature of the first absorption region is a series of relatively intense pairs of narrow bands. The intervals between the intense pairs are each *c.* 1260 cm.$^{-1}$, and this is also true of the weaker pairs. This frequency is probably to be associated with a vibration of the molecule

$$\begin{matrix} R \\ H \end{matrix} \diagdown C \rightarrow O$$

agreeing with the values found for other aldehydes. At lower pressures the bands at the long-wave end are fairly sharp but become less sharp at wavelengths shorter than *c.* 3500 A.; the point at which the diffuseness begins to be noticed varies with the pressure. At the long-wave end some of the bands show under higher dispersion (Hilger E 1 spectrograph) a distinct fine structure, the nature and magnitude of which is such that it may imply a rotation of the hydrogen atoms and the oxygen atom around an axis close to that of the C–C–C chain. These bands appear to have been analysed by Snow and Eastwood under still higher dispersion[2].

The illumination of acrolein vapour at room temperatures with light of frequencies corresponding to the first region of absorption leads predominantly to a polymerisation, which may imply a long life of the excited state and a much delayed dissociation. The experiments are being extended to propiolic aldehyde, the spectrum of which may show certain simplifications.

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J. W. LINNETT.

Old Chemistry Department,
University Museum,
Oxford.
Nov. 6.

[1] *Z. phys. Chem.*, **107**, 285; 1923.
[2] NATURE, **133**, 908, June 16, 1934.

## Points from Foregoing Letters

THE widespread infestation of potato leaves, especially of the Kerr's Pink variety, with early blight, is indicated by Dr. R. N. Salaman and Miss O'Connor, who describe its occurrence and dangers and indicate methods of checking its ravages.

The chemical combination of the carbon dioxide obtained from the air, with water, in order to form finally sugar, starch and other carbohydrates, occurs in green plants in several stages. Prof. E. C. C. Baly invokes three steps: (1) reaction of chlorophyll with carbon dioxide; (2) further reaction in presence of light to form carbohydrate; (3) Blackman reaction in darkness when chlorophyll goes back to original state.

Sevag and Maiweg's claim to have found a new substance, belonging to the oxime-group, which poisons the enzyme catalase (which increases the rate of liberation of oxygen from peroxides) is disputed by Prof. Keilin and Mr. E. F. Hartree, who find that the oxime solution of Sevag and Maiweg contains hydroxylamine, an already known poison for catalase.

Certain gases are adsorbed by given metals or metallic oxides and are thereby rendered more active in specific chemical reactions (activated adsorption). Prof. S. Roginsky discusses the rate at which such adsorption takes place and maintains that it does not agree with Taylor's theory of the phenomenon.

Prof. Dhar and others have shown that reacting gases absorb more light than the same gases separately. Prof. R. W. Ditchburn and Dr. H. J. J. Braddick find that the simple admixture of two non-reacting gases affects their light-absorbing power. Certain photochemical and astrophysical calculations may need revision in view of these results.

Dr. W. Sucksmith has measured the angle through which certain nickel alloys turn when submitted to varying magnetic fields (gyromagnetic effect). Nickel-copper alloys were chosen, the magnetic susceptibility of which at temperatures above − 14°, − 9° and − 2° C. varies inversely as the absolute temperature (that is, they are paramagnetic). Below these temperatures (Curie points) their susceptibility varies irregularly (that is, they become ferromagnetic). From his measurements Dr. Sucksmith infers that the paramagnetic behaviour of nickel alloys, like the behaviour of ferromagnetic substances in general, is due solely to the spin of the electrons and not to their orbital motion.

The increase in electrical conductivity shown upon drying, which he has measured in certain carbon-coated organic materials, is explained by Dr. Lars A. Welo as being due to the closer contact of the carbon particles when the materials shrink.

The bright-red colour which the wood of flowering plants gives upon chlorination (Maüle reaction) can be used as additional evidence that the family of Gnetales (of which the species *Ephedra*, growing on the sand-dunes of the Mediterranean, is the chief European representative), really belongs to the flowering plants, in spite of their cone-like flowers that have led botanists to include them among the non-flowering cone-bearing plants (Gymnosperms). Prof. R. C. McLean and Miss Myfanwy Evans find, in fact, that all three known genera of Gnetales give the Maüle reaction.

Dr. H. W. Thompson and Mr. J. W. Linnett have measured the light absorption of acrolein in the visible and ultra-violet and discuss the relation of the two absorption bands observed to the molecular structure of that compound. They find that illumination of acrolein vapour with light corresponding to one of the absorption bands leads to molecular aggregation (polymerisation).

## Research Items

**Iron Age Site, Kilpauk, Madras.** A preliminary report on the excavation of what promises to be an important site in the prehistory of southern India has been published by Messrs. M. D. Raghavan and T. G. Aravamuthan (*Current Sci.*, **3**, No. 3). The prehistoric cemetery of Kilpauk, Madras, situated in the garden of a bungalow belonging to Mr. E. R. Prudhomme, has been known for about twelve years, and a number of specimens of pottery and a small sarcophagus had been found in the course of laying out the garden. No attempt had been made to explore the site systematically until August last, when operations were begun on behalf of the Madras Government Museum. Up to the date of writing, the authors had extracted a quantity of black-tipped ware, in which the rim and inside are black and the rest red, all-black ware, a figurine of black pottery of high finish, apparently representing a bird, and half of a fine pottery head. Two iron objects were found, of which one was a small hoe blade of a very primitive type with a slightly curved cutting edge and a narrow butt, and the other a stick of iron, about six inches long. The most important find, however, was a sarcophagus about six feet in length, standing on six pairs of short legs, closely resembling specimens found at Pallavaram and Perumbair. It was filled with sand and bits of pottery. A fragment of a human tibia was found nearby. The sarcophagus had been badly damaged by a mango tree root and could not be removed whole. The site has certain distinctive features which mark it off from other prehistoric sites, such as the occurrence of both urn burials and sarcophagus burials, and the abundance of fine pottery. The all-black vessels distinguish Kilpauk from both Perumbair and Adichanallur. Beyond an attribution to the iron age of Southern India, it is as yet too early to attempt any precision in chronological classification.

**Pawnee Ritual Games.** The Pawnee ghost dance hand game has been made the subject of a study in cultural change by Dr. Alexander Lesser, based in part on field-work among the Pawnee Indians under a project supported by the Columbia Council for Research in the Social Sciences (Columbia Univ. Cont. to Anthropology, No. 16). The Pawnee first came under the United States Government with the purchase of the Louisiana territory in 1803. Their native economy of buffalo hunting accompanied by a digging-stick cultivation of corn and squash broke down with the coming of white settlement, and in 1874–76 they were moved from Nebraska to reservation land in Oklahoma. By 1892, when the Ghost Dance appeared among them, their culture had completely broken down, owing to a great extent to the efforts of the Government to substitute individual agricultural holdings for their village system. Their ceremonies had become functionless and extinct, while their arts, which had centred on the buffalo, had disappeared. They had nothing to look forward to and nothing to live by. The Ghost Dance gave them a new aspiration. In the form of the ritual among the Pawnee the hand game, a gambling game, which under the traditional culture had been associated with hunting and warfare, played an important part. Though there were no longer material stakes, there was still a feeling about winning and losing. In place of the opposing sides being based upon tribal divisions, they were constituted by such distinctions as 'visionaries' against 'innocents', men and women and the like. The incorporation of the hand game in the ghost dance ceremonial seems to have reached the Pawnee from the Arapaho. Only four other tribes appear to have developed the game in this manner. Not only did these games satisfy the desire for creative effort, but the ceremonies were the occasion of social gatherings on a large scale, which lasted over four days, meeting a real need when the tribe had been scattered over allotments.

**Bionomics of the Tsetse Fly on the Gold Coast.** The species of tsetse fly, *Glossina longipalpis*, Wied., is of great importance as a vector of human and animal trypanosomiasis in West Africa. Of the common tsetse flies, *G. longipalpis* appears to have been the least investigated. The bionomics of this insect in the country around the Gold Coast port of Takoradi forms the subject of a recent paper by Mr. K. R. S. Morris (*Bull. Ent. Res.*, **25**, part 3, Sept. 1934). It appears that the main food hosts of this species were bushbuck and duiker. When these small game animals were driven out of a specific fly-belt by farming and wood-cutting, the insect quickly and completely disappeared. Its distribution is dependent more upon humidity than upon temperature. The main vegetational types frequented by the insect are transition forest, inland savannah forest and coastal savannah, where the range of humidities is between 50 and 80 per cent (relative humidity) and the temperature between 75° and 85° F. It does not occur in the rain forest, where the relative humidity is above 80 per cent, or in the northern savannah, where it is as low as 30 per cent in the dry season. By statistical methods, coefficients of correlation were determined for the fly's density-activity and various climatic factors of the fly-belt. The main policy for control should lie in improving and directing the native's methods of bush cultivation. Farms should be as close to villages as possible, contiguous and kept under permanent cultivation. Clearings should be made at least 100 yards wide around bush villages and at least 200 yards wide around important towns. Small clearings and isolated farms are regarded as a danger.

**Habits of *Aequideus latifrons*.** The Cichlid fishes are always favourites in aquaria and have peculiar breeding habits, either attaching their eggs to some solid support and guarding them, or carrying them in the mouth until hatched. Mr. C. M. Breder, Jr., of the New York Aquarium, in "An Experimental Study of the Reproductive Habits and Life History of the Cichlid Fish *Aequideus latifrons* (Steindachner)" (*Zoologica. Sci. Contrib. New York Zoo. Soc.*, **18**, No. 1, 1934) studies a species which deposits its eggs on a substratum. The fishes were the aquarium-bred offspring of specimens collected in 1931 by Mr. A. Eisinger at Barranquilla, Columbia, and were brought to the New York Aquarium when still very small. Their behaviour appeared quite normal and like those studied under field conditions. Eggs may be laid every twenty-five days at a temperature of about 25° C., and hatch in two or three days. They are fanned by the parents' fins during the whole of the

incubation period, and the young are protected until another lot of eggs is ready to be laid. The parental care is strikingly shown in the way that both eggs and young are guarded in the aquarium, for they have many enemies and are eagerly eaten by the non-breeding adults present. If the fishes are disturbed they may remove the eggs altogether, taking them carefully one by one to some sandy hollow and incubating them there. The experiments devised in this research are ingenious, and the sketches and photographs which accompany the paper are very interesting.

**Resistance of Mice to Irradiation.** Jerome Davis (*Amer. Nat.*, **68**, Sept.-Oct. 1934) discusses the results which he has obtained on the effect of ultra-violet light on mice. Six generations of hairless mice were subjected to ultra-violet light, and a control group was maintained which did not receive this treatment. Three animals from two litters of the sixth irradiated generation, and two controls of the same age were irradiated together. Slight peeling began on the controls after one exposure, but in the experimental animals not until after the fourth exposure. At the end of fifteen exposures, the controls were severely burned, whereas the experimental animals were only slightly so. In the experimental group the burns disappeared within six days, leaving the animals quite normal. The controls, on the other hand, developed hard callouses due to hyperplasia of the epithelium. Davis tentatively suggests that the difference in response to irradiation between the irradiated and control mice may be due to the inheritance of acquired resistance to irradiation. The author, acknowledging that the results are inconclusive, suggests that they may incite others to repeat and extend his work. But it is to be hoped that he will stage a Mendelian experiment with his own stock. It should be a simple matter to show that the tolerance is, or is not, indeed inherited.

**Evolution in the Agarics.** A long paper by Mr. E. J. H. Corner of Singapore, "An Evolutionary Study in Agarics; *Collybia apalosarca* and the Veils", has appeared (*Trans. Brit. Mycol. Soc.*, **19**, 39–88, Oct. 1934). The account traces the formation and anatomy of the fruit body of *C. apalosarca*, a toadstool-like fungus found growing on wood in Malaya. Characters of the species are given in detail, whilst a new form, *radicans*, and a new variety, *perstipitata*, are also described. The structure of the mature fruit body has been investigated microscopically, and times of spore shedding are correlated with size of the fructification. *C. apalosarca* forms an evolutionary link between *C. radicata* and *Armillaria mucida*, and several interesting comparisons are drawn. For example, the 'root' of *C. radicata* is represented by the lower half of the stem in *C. apalosarca* and by the stem and persistent ring of *A. mucida*. *C. radicata* is supposed to have developed from a naked ancestor; *C. apalosarca* and *A. mucida* from a similar veiled ancestor, whilst the newly-described form and variety mentioned above are intermediates which uphold the hypothesis.

**Oxidising Agents as Fertilisers.** Iyer, Rajagopalna and Subrahmanyan (*Proc. Indian Acad. Sci.*, **1**, No. 2, p. 106) describe interesting effects of various oxidising agents on crop yield and certain chemical and biological transformations in the soil. Some remarkable increases in yield are recorded, up to 100 per cent, for example, with tomato plants on soil treated with manganese dioxide. Certain other crops responded better to potassium permanganate. Ammonification, with organic manures, was slightly favoured by oxidising agents, and increased oxidation of organic matter was demonstrated by the increased production of carbon dioxide corresponding to the loss of carbon. The treatment also resulted in a temporary increase in the numbers of bacteria and Actinomyces, whilst in some cases depression of fungi occurred. It appears that the results are due more to the facility with which the added substances part with their oxygen than to the effect of the metallic ion, hydrogen peroxide producing effects similar to those of manganese dioxide. Increased formation of bacterial food and consequent increased activity may be involved as well as direct oxidation of organic matter to simpler substances and carbon dioxide.

**Deformations of the Crust around Sakura-jima (Japan).** Until 1914, Sakura-jima was a volcanic island at the northern end of Kagoshima Bay. After the great eruption on January 12 of that year, it was joined by a stream of lava to the mainland. Series of precise levellings were carried round the head of the bay in 1891–98, 1914, 1915, 1919 and 1932. Prof. C. Tsuboi (*Earthq. Res. Inst. Bull.*, **7**, 103–114; 1929) examined the changes during the first two intervals. The graphs are similar in form; each consists of segments of straight lines, and the ends of segments lie on the same abscissæ, which, according to Tsuboi, correspond with the boundaries of six crust-blocks round the head of the bay. In three of these blocks, the amounts of tilting were 9″, 10″ and 12″, and the directions converge towards a point a short distance to the north of the crater. Prof. N. Miyabe has continued the work for the last two intervals (*Bull.*, **12**, 471–481; 1934). In both, the vertical displacement was reversed in direction, the recovery being at first somewhat rapid. In one crust-block (west of the volcano), the tilting occurred in the same direction as before. In the other two (to the east), the direction of tilting was almost exactly reversed, though less in amount.

**Meteorology of the West Indies.** The "Handbuch der Klimatologie" of W. Köppen and R. Geiger when complete will be in five volumes (Berlin: Gebrüder Borntraeger, 1934). A number of different parts of this work have already appeared as each has been completed, of which the most recent (Band 2, Teil 1) is entitled "Climatology of the West Indies". The text of this was written in 1927 by the late Prof. R. de C. Ward, formerly professor of climatology at Harvard University, who compiled his account largely on the basis of summaries by W. W. Reed that had appeared a year earlier in the *Monthly Weather Review*. Prof. C. F. Brooks, director of Blue Hill Observatory, with the help of Miss E. M. Fitton and others, extended the tables and summaries; finally Prof. Ward revised the whole work shortly before his death. European meteorologists hear of these regions chiefly in connexion with tropical hurricanes, but the introductory part of this work shows that there are other aspects of their meteorology of almost equal interest. The West Indies show great uniformity of temperature, such as is to be expected of islands of which the greater number lie just within the tropics, but those nearest to the mainland of Central America feel to some extent the effect of the winter cold waves of North America, resulting from south-

ward incursions of polar air; the more easterly and southerly members of the group escape these effects and have a correspondingly small annual range (2° C. only at Barbados). While temperature changes are unexciting and the simple régime of the north-east trade winds is only rarely disturbed by a hurricane, rainfall shows great variability both in the amount experienced in different years at one place and in the normal amount received at places no great distance apart. At Silver Hill, Jamaica, the total fall in three days, November 5–7, 1909, was 2,159 mm. (85 in.) and in the seven days to November 11, it was 3,428 mm. (135 in.). In the same island, two places only 30 miles apart and differing in elevation by only 189 metres have normal annual totals of 735 and 5,638 mm. respectively. The numerous detailed tables in this work repay study, for example, Table 12, which shows thunderstorm frequency. Some of the islands have only about the same number as the English Midlands, but at Port au Prince (Haiti) the annual frequency is about 107.

**The Energies of the Positrons in Induced Radioactivity.** Y. Nishira, R. Sagane, M. Takeuchi and R. Tomita (*Sci. Pap. Inst. Phys. Chem. Res., Tokyo*, Sept. 1934) have investigated the energy distribution spectrum of the positrons emitted for radio phosphorus ($_{15}P^{30}$) obtained by activating aluminium by bombardment with α-particles. The activated metal was brought up to a Wilson cloud chamber arranged in a solenoid. The positrons passed through a thin aluminium window into the chamber. The energy distribution is apparently continuous, with a maximum intensity about $0{\cdot}8 \times 10^6$ e.v., and the upper limit of energy is probably in the neighbourhood of $4 \times 10^6$ e.v. The results are compared with those obtained by Curie-Joliot, Meitner, Alichanow and others, and by Ellis and Henderson, and published in recent papers. Most of these authors find a rather lower value for the energy at the upper limit. It is suspected that there are other peaks in the energy distribution, but these may well be due simply to statistical fluctuations.

**Fast Mercury Ions and the Excitation of X-Rays.** D. H. Sloan and W. M. Coates have recently described the further development of the Laurence-Sloan apparatus for accelerating heavy ions in stages to energies of the order 3 million volts (*Phys. Rev.*, Oct. 1). The ions travel through a series of copper tubes which are connected alternately to opposite poles of a high-frequency circuit, and the length of the accelerators is so arranged that an ion once accelerated into the first cylinder passes from one to another always at the right time to receive an acceleration. Detail improvements in the accelerators and their connexions enable higher voltages to be employed than formerly. The maximum voltage applied is 79,000 volts at about 10 megacycles, and about 10 kw. is supplied to the oscillator. About $10^{-8}$ amp. of mercury ions were obtained at $2{\cdot}8 \times 10^6$ volts. A second paper by W. M. Coates describes the production of X-rays by mercury ions having energies up to 2·4 million electron volts. The X-rays were definitely produced by the ions since they were unaffected by the use of electric and magnetic fields sufficient to eliminate cathode rays from the beam striking the target, while they were stopped by a foil which stopped the positive ions but would be transparent to X-rays produced in other parts of the tube. No radiation was observed from targets of lithium, boron, oxygen, sodium, nickel or copper. X-rays were detected and the absorption coefficients measured in aluminium and air, for the target elements aluminium, sulphur (probably *K*-radiation), bromine (probably *L*-radiation), molybdenum, silver, tin and lead (radiation not identified with certainty). The radiation was in all cases too weak to measure below 300 kv., and increased rapidly with increasing energy of the ions. It is suggested that these rays are produced by the bombarding ion and the target atom approaching sufficiently close to form a quasi-molecule with the two *M* shells (say) overlapping. When the 'molecule' breaks up, one of the atoms loses one of its inner electrons and the subsequent rearrangement gives rise to characteristic radiation. The observed threshold value for the energy of the exciting ion gives a distance of approach of the two nuclei which agrees roughly with this hypothesis.

**Tidal Friction and Planetary Motion.** Much time and labour were devoted by the late Sir G. H. Darwin to a step-by-step investigation of the cumulative effects of tidal friction upon the motion of the earth and moon. Lord Kelvin suggested that a more general and less laborious treatment could be obtained by considering the energy and angular momentum. In recent times the problem has been taken up again, by the aid of general theorems in Hamiltonian dynamics. T. Levi-Civita, who has himself worked on the subject, gives (*Amer. Math. Mon.*, **41**, 1934) an account of the methods used by G. Krall, which are remarkable in that they enable one to describe the behaviour of a planetary system after an indefinitely great time without calculating the intermediate stages. The conclusions are that everything tends towards a state of uniformity, in which all the bodies will describe circular orbits about their common centre of mass with equal angular velocities. Moreover, each axis of rotation will be perpendicular to the orbital plane, and the period about this axis will be the same for all. In other words, on each planet the length of the year will be the same, and also the length of the day, and there will be no distinction between summer and winter. The above results are for systems which have kinetic energy of rotation comparable with that of translation. A case which has not yet been worked out is that in which the resultant angular momentum is zero. The ultimate fate of such a planetary system would be a catastrophe in which all the bodies collided.

**Sunspot Numbers.** Tables of monthly and annual sunspot numbers from 1749 to 1933, as determined at Zurich, are given in the September issue of *Terrestrial Magnetism and Atmospheric Electricity*, and are accompanied by a similar table, for the years 1917–33, of the sunspot numbers derived from the central zone of the sun, and a table of monthly intensity of ultra-violet solar radiation at Mount Wilson for the period 1924–33. Diagrams for 1923–33 of the central-zone *daily* sunspot numbers, and of the international daily magnetic character figures, arranged in 27-day sequences, are given by J. Bartels, and illustrate again the fact that strong and long-lived active regions occur on the sun, which affect the earth's magnetic state, even throughout periods in which the sun is practically spotless. The same issue contains two articles, by H. W. Wells and L. V. Berkner, on measurements of the *E* and *F* ionised layers of the atmosphere above Huancayo, in Peru, at latitude 12° S.

# The British Institute of Radiology

## ANNUAL CONGRESS AND EXHIBITION

THE eighth Annual Congress of the British Institute of Radiology, and an exhibition of radiological apparatus organised by the X-ray industry were held at the Central Hall, Westminster, on December 5–7. The morning of December 6 was devoted to the reading of physical and technical papers, contributions being made by Prof. F. L. Hopwood, Dr. A. Müller, Dr. R. E. Clay and Mr. A. G. Warren.

Prof. Hopwood, giving a demonstration of induced radioactivity, traced briefly the history of the subject starting with the work of M. and Mme. Joliot (1933), who by bombardment with α-particles, induced radioactivity in various substances of atomic number less than that of potassium. He referred to the work of Cockroft and Walton, who produced similar effects with high-speed α-particles, and also to the various results obtained with neutrons, stating that Fermi has excited fifty elements. Prof. Hopwood and his colleagues at St. Bartholomew's Hospital have found that induced radioactivity can be brought about by neutrons emitted from beryllium irradiated by γ-rays. Following on this work, they endeavoured to induce radioactivity by means of high-voltage X-rays. No effect could be detected as a result of irradiation by X-rays excited at 200 kv. or at 400 kv., but the desired effect was produced by X-rays produced at much higher voltages. Bromoform was used for the purpose, and after irradiation in Germany, the sample was brought to London by air and the radioactive bromine separated by chemical means (see NATURE, Dec. 8, p. 880). Bromine apparently gives rise to two radioactive forms, one having a half-value time of about 6 hours, and the other having a half-value time of 30 minutes. It was stated that radioactivity has now been induced in all the elements found in the human body except calcium and hydrogen.

For the purpose of demonstration, Prof. Hopwood showed, by means of a Geiger counter, the induced radioactivity in aluminium (slightly active) and in silver (strongly active). The latter case was of particular interest, as the half-value period of the silver is about 3 minutes, and the decay could readily be detected. Induced radioactivity in a piece of ivory was also demonstrated.

Dr. A. Müller and Dr. R. E. Clay gave a paper on the "X-ray Plant at the Davy-Faraday Laboratory". The simplest apparatus, a small induction coil with a Wehnelt interrupter operating an X-ray tube of the gas type, was demonstrated, and typical crystal photographs were made and developed in the course of the lecture. The authors then pointed out that the principal difficulty in designing high-powered X-ray equipment lies in dissipating the heat generated at the target, and showed mathematically that the maximum permissible loading of a tube depends on the square root of the area of the focus. If the focus is to be kept small and the power increased, recourse is had to a tube employing a rotating anode, and a tube, capable of withstanding a continuous loading of 16 kw. (450 ma. at 35 kv.), has been made and found satisfactory. This tube embodies a target about 20 in. in diameter, rotating at a speed of 2,000 rev. per minute. Using a high-powered X-ray tube of this type, it is possible to work with crystal-film distances of 3 metres, and so obtain a very high resolving power.

The authors are considering the design of a tube capable of handling 50 kw. but are of the opinion that it would not be possible to go to much higher powers, since the maximum permissible loading of a tube having a rotating anode varies only as the square root of the peripheral velocity. Tubes of power much greater than 50 kw. would therefore have to be very large and to rotate at high speeds, and the mechanical stresses would approach the ultimate strength of steel.

Mr. A. G. Warren, in a paper on "The Detection of Small Flaws in Metals by Radiography", discussed in considerable detail the detection of cracks and 'flakes' particularly in steel. He showed that the possibility of detecting cracks radiographically depends partly on their dimensions and partly on their obliquity to the X-rays, and that over a wide range of dimensions a criterion could be found from consideration of the area of cross-section of the flaws. The minimum cross-section of a detectable flaw can be found by ascertaining the cross-sectional area of the finest wire, laid above the specimen, which could be detected on the radiograph. As an example of the minimum size detectable, Mr. Warren showed that, in steel 1 in. thick, a crack of width 0·004 in. and a depth exceeding 0·02 in. can be detected with certainty.

The fifteenth Mackenzie Davidson Memorial Lecture was given on December 7 by Sir William Bragg, on "X-rays and the Coarse Structure of Materials". After explaining briefly the rudiments of the subject, he described recent work carried out on organic ring compounds, and showed that by X-ray means it is possible to make a kind of 'contour map' giving the distribution of electron density in the crystals, which reveals a structure agreeing closely with that arrived at from considerations of the chemistry of the substances. The energetics of substances can be studied by chemical means and also by consideration of the electrical forces holding the atoms together, and the two methods give similar results, but indicate tensile strengths much higher than those usually observed. The discrepancy is attributed to surface defects, which have the effect of weakening the structure, and recent experiments have shown that if the experimental conditions are arranged so that the weaker parts of the sample are not stressed, values for tensile strengths agreeing with those calculated are obtained.

Higher values for tensile strengths are obtained in a vacuum than in air—a result attributed to the effect of water vapour absorbed in interstices, which has the effect of reducing the electrical forces. A piece of mica cleaved in a vacuum will recover when the surfaces are put into contact again, although in air the cleavage is permanent. This effect may be explained on the assumption that water vapour absorbed from the air disturbs the electrical field and prevents cohesion taking place, while in a vacuum the electric field is stable and cohesion readily occurs.

A new apparatus of interest to physicists shown at the exhibition was a high-voltage rectifier of the copper oxide type capable of withstanding an inverse voltage of 200 kv. and passing a current of 30 ma. The complete rectifier is built of smaller units arranged in series, mounted in oil in a metal case and provided with suitable insulators for operation at high potentials to earth.

## Centenary of the University of Brussels

THE Université Libre de Bruxelles was founded on November 20, 1834, by Theodore Verhaegen (1796–1892) and a group of friends, a few days after the opening on November 4 of the Catholic University at Louvain. It was housed at first in the buildings now occupied by the Musée Moderne, but was removed in 1842 to the site in the rue des Sols which it occupied until recently. After the War, mainly through the generosity of the "Commission for Relief in Belgium" and the Rockefeller Foundation, a new Cité Universitaire was created at Solbosch, adjoining the Bois de la Cambre. These buildings include a very fine hall and library with appropriate buildings for the faculties of arts and law, whilst the faculties of science are housed in a capacious but more utilitarian building behind the main frontage. A large hostel has also been provided for men and women students, with generous accommodation for non-residents.

The centenary celebrations extended over three days, November 18–20. On the evening of November 18, a reception was given by the Collège des bourgmestres et échevins at the Hotel de Ville, where the guests were received by Bourgmestre Max. The principal function took place in the hall of the University in the presence of H.M. the King of the Belgians. This session was presided over by Bourgmestre Max, and addressed by M. Paul Hymans (Foreign Minister), M. Maistriau (the retiring Minister of Public Instruction), and representatives of past and present students. The Rector, M. Bogaert, announced the names of some twenty-five new doctors *honoris causa*, of whom the first was the King himself. In addition to those associated with the faculties of philosophy and of law, the faculty of medicine had nominated Sir Henry Dale, director of the National Institute for Medical Research in Great Britain, Prof. van den Bergh of the University of Utrecht, and Sir Frederick Gowland Hopkins, president of the Royal Society. The faculty of pure science had nominated Profs. Cayeux, Cotton and Hadamard, members of the Institut de France, Prof. Krismer, emeritus Professor of the École Militaire at Brussels, and Prof. T. M. Lowry of the University of Cambridge. The faculty of applied science had nominated M. Pelseneer, permanent secretary of the Académie Royale de Belgique, Prof. Swarts of the University of Ghent, Prof. Debye of the University of Leipzig (at present visiting professor at Liège on the Francqui Foundation) and Prof. Janet, honorary professor of the University of Paris. At the conclusion of the ceremony, the past and present honorary doctors were received by the King in person.

Public lectures on legal and philosophical subjects were given in the afternoon, and in the evening of November 19 the guests were entertained at dinner by M. Hymans at the Fondation Universitaire. The celebrations were continued on Tuesday, November 20, and concluded with a banquet in the University hall, which was attended by 826 guests.

The celebrations were marked by much enthusiasm and were of an extremely hospitable character. There can be no doubt that in its new quarters the University has every prospect of a brilliant and successful future.

## Archæological Excavations in Shetland

MR. A. O. CURLE gave an interesting account to Section H (Anthropology) at the Aberdeen meeting of the British Association on the excavation conducted by him during the past four years in Shetland. A low promontory projecting into the Voe which lies sheltered behind the lofty promontory of Sumburgh Head, the most southerly point of Shetland, bears on its crest the ruin of a late sixteenth century dwelling house, to which Sir Walter Scott in "The Pirate" gave the name of "Jarlshof". Beneath and all around this ruin lie numerous remains of ancient dwellings, ranging from before the Bronze Age reached Shetland in the latest phase of that culture, through the period of the brochs and their secondary buildings, to the coming of the Norsemen in the ninth or tenth century and even later, for relics found in the vicinity of foundations exposed last summer indicated for them a fifteenth or sixteenth century date.

A storm some thirty years ago exposed a range of buildings on the sea front, which were at that date excavated by the proprietor. These consisted of the remains of a broch and a series of later buildings extending probably well into the Christian era. The Office of Works, having accepted guardianship of these remains, resolved to explore the ground in the immediate vicinity, and invited Mr. Curle to direct the operations on its behalf. The work has now been in progress for a short period each year since 1931. A group of prehistoric dwellings five in number, all lying practically contiguous to one another, have been explored and apparently exhausted. A dwelling, excavated during the past summer, was found to consist of an open court some 20 ft. long and 10 ft. broad, rounded at the inner end, with lateral chambers on the sides. The paving suggested the presence of cattle inside the house, a practice followed in much later days. This was confirmed by the discovery of a whale's vertebra, fixed into a wall to furnish a loop for a tether. This dwelling had been partially broken down and then extended by further constructions in front of the original entrance. From this later building a drain had been carried towards lower ground to the south-east. Evidence of a still later period was the closing of that drain by a stairway leading to another dwelling. This second dwelling was obviously of much later construction than the first. In its turn it had had three periods of occupancy, the earliest of which was seemingly contemporary with the latest occupation of the first house. The third occupation of the second house was remarkable for evidence of the advent of artificers in bronze, who cast swords and axes in clay moulds. These dwellers closed the original entrance, which lay at the foot of the stair above referred to, and opened a new entrance at the opposite end of the house. The bronze workers used clay moulds, and, to release their castings, broke the moulds and threw the fragments over the closed entrance and into disused chambers beyond, where they lay, not on the floor level, but in the

soil which overlay them. While using bronze, the people were also employing artefacts of stone and of slate. They also cultivated grain, using a species of barley. In their mode of life they were pastoral, and seem to have drawn little from the sea except shell-fish. Adjacent to the second dwelling lies a third, which in its turn had been subjected to three different occupations. The first and the second of these occurred during the final phase of the Bronze Age in Shetland, and the last after bronze had given place to iron.

This past season, while it saw, seemingly, the termination of the excavation of the prehistoric site, witnessed the opening of a fresh epoch in the exploration of a settlement of the early Norse invaders. A house has been uncovered measuring nearly 100 ft. in length, 12 ft. in breadth at either end, and 17 ft. 6 in. in the centre, the walls of which in part still stand to a height of 3 ft.—probably not much below the original elevation, as the superstructure would be of wood and turf with a roof of timber, partially supported on posts.

Numerous relics have been found, including combs and pins of bone, pins of bronze and a remarkable collection of pieces of slate bearing lines and devices in graffito. One of these, a tablet 7 in. × 2 in., shows a Viking galley with high prow and stern, with mast and steering oar, and the crew indicated by strokes rising from the deck.

Evidence of other buildings of the Norse period has been discovered, and further exploration should produce interesting results.

## Technical Aspects of Emulsions

A SYMPOSIUM on the technical aspects of emulsions, organised by the British Section of the International Society of Leather Trades' Chemists, was held on December 7 at University College, Gower Street, Prof. F. G. Donnan being in the chair, and the attendance numbering more than two hundred.

Dr. W. Clayton dealt with the subject of emulsions from the point of view of the patent literature, particular mention being made of the modern idea of 'balanced' emulsifying agents with lipophile-hydrophile groups, and several patent specifications claiming the use of a preformed emulsion as an emulsifying agent of unusual virtue. Dr. R. M. Woodman discussed the problem associated with the preparation of emulsions for horticultural spraying. The formation of opposite type emulsions with one pair of liquids and the same emulsifier, the stability to ageing and to subsequent mechanical treatment of the two types in dual systems near the common phase volume ratio, and the danger to plants arising from the use of these dual emulsion systems were some of the main points discussed.

Emulsions and emulsification in the wool textile industry were the subjects of the contribution by Dr. J. B. Speakman and Dr. N. H. Chamberlain, and it was shown that the ease of removal of thin films of oil from textile fabrics is determined by adhesion phenomena as well as by the magnitude of the oil-water interface. Dr. J. W. Corran raised some interesting points in connexion with the manufacture of mayonnaise, a typical food emulsion. Egg yolk, due to the lecithin present, is the most effective edible substance in the preparation of the emulsion, but another substance, cholesterol, antagonises this action. The superiority of fresh egg as compared with preserved yolk is due not only to hydrolytic changes in the lecithin on keeping, but also to the increased relatively unfavourable influence of the cholesterol. The mustard used in manufacture confers an added margin of stability on the product. The influence of the method of mixing, etc. was discussed at some length.

Mr. R. I. Johnson described various types of agitators, colloid mills and homogenisers used in the production of industrial emulsions. The chief factors influencing the design of homogeniser pump systems and the homogenising valve were considered and reference was made to two-stage homogenisation. Mr. R. Dorey detailed some work on the effect of the mode of preparation on the dispertion of soap-stabilised emulsions, taking as examples emulsions of (*a*) olive oil with sodium oleate and (*b*) arachis oil and potassium oleate. The results given in the form of size frequency analyses indicate that the dispersion of this type of soap-stabilised emulsion is improved if the soap is allowed to be formed *in situ* during the emulsification process.

The mechanism of emulsification was dealt with by Prof. H. Freundlich. The stabilising influence of gases on emulsions produced by ultrasonic waves is most likely a secondary effect, thin layers of gas on the surface preventing or retarding the coalescence of the droplets. Ultrasonic waves acting upon an emulsion (or a coarse suspension) in a thick-walled capillary tube cause striations owing to stationary longitudinal waves in the liquid. In the nodes of these striations large drops are formed, presumably owing to an orthokinetic coagulation of the droplets when travelling from the antinodes to the nodes. It is probable that the facts which are instrumental in the formation and destruction of emulsions by ultrasonic waves are of general importance when producing emulsions by any mechanical means.

Dr. L. A. Jordan discussed the stability of emulsions in thin films with special reference to emulsion paints of the oil-in-water type. The emulsifying agent is absorbed upon the oil-water interface, and the conditions of formation of the interfacial layer determine the ageing effects produced on emulsions. One necessary condition is adsorption in one phase and solution in the other of the emulsifying agent forming the interface, while stability is dependent upon the formation of a tightly packed orientated stable monomolecular layer.

L. G. Gabriel detailed the methods of preparing asphaltic bitumen emulsions. He mentioned that it has been established that high viscosity emulsions prepared from some bitumens are due to the presence in the bitumen of finely divided water-soluble substances which serve to produce an osmotic equilibrium between the solutions, which they form inside the dispersed bitumen particles, and the bulk aqueous phase without. This work has led to a means of varying the viscosity of such emulsions without changing the bitumen content. Emulsions in the leather industry was the subject of the contribution by W. R. Atkin and F. C. Thompson. The process of fat-liquoring consists of two stages, first the absorption of oil from the dilute emulsion, and the electrical

discharge of oil droplets, and secondly the breaking of the absorbed emulsion by acid and by basic chromium compounds in the interior of the leather.

A valuable application of emulsions to medical science was afforded by a paper by V. G. Walsh and A. C. Fraser on the use of highly dispersed emulsions in the treatment of toxæmic conditions. It dealt in the main with the practical application of the observation that if very large doses of toxin are incubated at body temperature for half an hour with olive oil-soap emulsion, they are rendered non-toxic when injected intravenously. This has been made the basis for the treatment of toxæmic conditions, and more particularly of lobar pneumonia. Other points discussed were the selective adsorption of toxin by emulsion and the administration of vaccines and certain drugs in combination with emulsion, which enabled larger doses to be given without the usual effects of overdose, etc.

H. B. Stevens and W. H. Stevens dealt with the question of rubber latex, and pointed out that much scientific investigation is still required to elucidate the facts underlying all the commonly used processes for coagulating rubber latex.

## University and Educational Intelligence

BIRMINGHAM.—With the object of creating a memorial to the late Sir Bertram Windle, first professor of anatomy and first dean of the faculty of medicine in the University, Sir Charles Hyde has given £5,000 towards the cost of the new dissecting room to be built at the new medical school on the understanding that it shall be called the "Bertram Windle Dissecting Room". Sir Charles has also given £300 to found a 'Windle prize' to be competed for by students in the Department of Anatomy. In his letter to the Pro-Chancellor, Sir Charles writes: "I am glad to offer these donations as I realise that they will not only carry out the object I have in mind but will also to some extent assist in the finance of the new Medical School which is naturally causing some anxiety to the Council and to yourself."

CAMBRIDGE.—W. S. Mansfield, Emmanuel College, has been appointed director of the University Farm.

Dr. W. B. Lewis has been elected to an unofficial (Drosier) fellowship for research in physics at Gonville and Caius College.

UNEMPLOYMENT among teachers is serious throughout the United States. In a recent report by the New York City Board of Education examiners, it is stated that applicants now on the eligible list have waited so long and are presumably so rusty that new examination should be required before they are appointed. The report adds that their attitude toward education, toward society, toward life itself is unquestionably antagonistic and many have embraced a radical social and political philosophy. Among the teachers there is a prevalent opinion that the fundamental industries of providing food, clothing, warmth and shelter should be divorced from profit and be conducted solely for the general welfare, as are lighthouses, highways, parks and schools. Not only so, but their National Education Association proposes they should teach this doctrine in the schools.

## Science News a Century Ago

### Resources and Statistics of Nations

"Under the above title," said the *Times* on December 17, 1834, "the first part of a work which promises to be a very useful one has just made its appearance. It is the undertaking of John M'Gregor Esq. F.S.S. . . . This new work on statistics confines itself to facts, and presents to its readers a collection of tables of the physical aspect, area, civil and natural divisions of countries, population, produce of mines, of agriculture, of forests, etc.; of manufactories and fisheries etc.; military and naval forces, seaports, colonies, roads, bridges, canals and, in short, of everything connected with the science of political economy, of every nation on the globe; which tables are the result of much personal observation and of the most authentic public and private documents which are furnished by the Governments of the different countries, and by the most accurate writers by whom the science has been illustrated. . . . The work which is about to be translated into the French and German languages . . . is at once concise, perspicuous and comprehensible."

John Macgregor, the author of this work, was born in 1797 and died in 1857. He spent many years in America, in 1840 became joint-secretary of the Board of Trade in London, and in 1847 was elected M.P. for Glasgow.

### Dublin and Kingstown Railway

The last railway to be brought into operation in 1834 was that from Dublin to Kingstown. The official opening took place on December 17, and on that day the *Times* correspondent wrote: "This day our Kingstown Railroad opened, under very favourable auspices, crowds thronged the offices at Westland-row and every hour a full train of carriages started 'at high pressure'. Everyone engaged in the works seems in excellent spirits at the satisfactory state of the road, engines, carriages, etc. All the machinery works well as yet, except in one particular: the springs are not sufficiently elastic to prevent sudden shocks when the carriages stop. Three or four gentlemen had on one occasion to-day their heads knocked against each other and the carriage doors, and severe contusions were the consequence. A county of Kildare gentleman's head was laid open. The majority had, however, hard Irish heads and did not mind a few knocks. The directors have prepared a splendid entertainment at Kingstown for their friends and the subscribers to the undertaking. The weather is delightful for December, and a few broken heads does not throw much damp on a scene of Irish amusement where everything else goes well."

### Elections to the Royal Society

At a meeting on December 18, 1834, Sir Benjamin Brodie in the chair, thirteen additional candidates were elected into the fellowship, making a total of fifty elected in the course of the year. Their names were: the Rev. John Barlow, the Rev. James William Bellamy, William Brockedon, Thomas Galloway, Dr. Bisset Hawkins, Andrew Leith Hay, Francis Kiernan, George Lowe, Richard Owen, Benjamin Phillips, Richard Saumarez, Charles John Tynte, John Gardner Wilkinson.

The list is noteworthy for the inclusion of two candidates who afterwards each achieved the

distinction of the Copley medal, namely, Francis Kiernan (1836) and Richard Owen (1851). In medical science the former made important contributions respecting the structure of and circulation through the liver. He was one of the founders of the University of London. [Sir] Richard Owen, at the time of his election, was assistant conservator, Royal College of Surgeons, and lecturer in comparative anatomy at St. Bartholomew's Hospital. Most of his early papers were read before the Zoological Society; in 1832, however, the Royal Society published (*Phil. Trans.*) his elaborate study entitled, "On the Mammary Glands of the *Ornithorhynchus paradoxus*". Owen became first Hunterian professor (1835); and superintendent of the Natural History Department, British Museum (1856). In the "Life" of Darwin it is recorded that Owen, a strong opponent of Darwin's views, contributed "a bitter and anonymous article on the 'Origin of Species' to the *Edinburgh Review* of 1860".

### The *Beagle* Leaves the Chonos Archipelago

On November 10, 1834, the *Beagle* sailed southward from Valparaiso to survey the Chonos Archipelago as far south as the Peninsula of Tres Montes. The survey occupied about a month and on December 18 Darwin wrote: "We stood out to sea. On the 20th we bade farewell to the south, and with a fair wind turned the ship's head northward. From Cape Tres Montes we sailed pleasantly along the lofty weather-beaten coast, which is remarkable for the bold outline of its hills, and the thick covering of forest even on the almost precipitous flanks. The next day a harbour was discovered, which on this dangerous coast might be of great service to a distressed vessel. It can easily be recognised by a hill 1,600 feet high, which is even more perfectly conical than the famous sugar-loaf at Rio de Janeiro. The next day after anchoring, I succeeded in reaching the summit of this hill. It was a laborious undertaking, for the sides were so steep that in some parts it was necessary to use the trees as ladders. There were also several extensive brakes of the Fuchsia, covered with its beautiful drooping flowers, but very difficult to crawl through. In these wild countries it gives much delight to gain the summit of any mountain. There is an indefinite expectation of seeing something very strange, which, however often it may be balked, never failed with me to occur on each successive attempt. Everyone must know the feeling of triumph and pride which a grand view from a height communicates to the mind. In these little frequented countries there is also joined to it some vanity, that you perhaps are the first man who ever stood on this pinnacle or admired this view."

### Dundonald's Rotary Steam Engine

The *Mechanics' Magazine* of December 20, 1834, contains an illustrated account of the rotary steam engine invented by the famous naval commander Thomas Cochrane, tenth Earl of Dundonald (1775–1860): "We give a place to the present description of it in our pages," said the *Mechanics' Magazine*, "for two reasons . . . first because of the considerable talk about it owing partly to the celebrity (for other things than machine inventing) of the noble inventor, and partly to his prodigiously confident representations of its amazing capabilities, and secondly because if we are wrong in the opinion we have formed of it . . . it would be a thousand pities that the knowledge of an invention, calculated to confer so much benefit on the mechanical world, and to save so much trouble and mortification to hundreds of ingenious mechanics, who are now occupied with the solution of that problem of *which it is said to furnish the best possible practical solution*, should not be as speedily and as widely diffused as possible." Later on, Dundonald was allowed to fit one of his rotary engines in H.M. Paddle Sloop *Janus*, but it proved a failure and was removed from the ship. This engine formed the subject of one of the many reports which Airy, the Astronomer Royal, from time to time made at the request of the Admiralty.

## Societies and Academies

### PARIS

**Academy of Sciences**, November 5 (*C.R.*, **199**, 897–988). JEAN TILHO: Two sketches concerning the final capture of the Lagone and its consequences for the Tchad basin. Sketch maps illustrating the author's previous communication on the same subject, and further remarks on the serious consequences which would result in the Tchad area. MARIN MOLLIARD: Heather and mycorrhiza. Results on the culture of *Calluna vulgaris* under aseptic conditions: the views of Rayner as to the necessity of the presence of a mould for normal growth are not confirmed. CHARLES ACHARD, AUGUSTIN BOUTARIC and JEAN BOUCHARD: The action of sera on the fluorescent power of solutions of uranine. The fluorescent power of uranine solutions is unaffected by the addition of normal sera (horse, man), and this is also the case with sera from subjects suffering from various diseases. The blood of cancerous patients, however, causes a marked reduction of fluorescence. JULES HAAG: Self-maintained oscillations. J. CABANNES: Theoretical considerations on the luminescence of the upper layers of the atmosphere. The luminosity of the night sky is regarded as a phosphorescence phenomenon in a gaseous mixture of metastable nitrogen, ozone, oxygen and water vapour. HENRI DEVAUX and JEAN CAYREL: The influence of temperature on the electrical conductivity of cupric sulphide in thin layers. The considerable changes in the conductivity of thin layers of cupric sulphide produced by a rise of temperature are attributed to loss of water. LUCIEN DANIEL: Deficient seeds in the grafted Jerusalem artichoke. E. J. GUMBEL: The paradox of the limit age. DAVID WOLKOWITSCH: A generalisation of a theorem of Monge. ALFRED ROSENBLATT: The application of Picard's method of successive approximations to the study of equations of the second order, elliptical and non-linear, with three independent variables. CORNELIS VISSER: The angular derivative of univalent functions. HENRI CARTAN: Pseudo-conformal transformations of the topological product of two domains. TCHANG TE-LOU: A new method for the study of detonation in the motor. It is not sufficient to measure the maximum pressure produced by the detonation: the variation of $dp/dt$ with the time is a better measure of the shock. An apparatus is described which records the curve $dp/dt$ as a function of time. Reproductions of four of these curves are given, showing the effect of advancing the spark. DANIEL BARBIER: The reality of the correlation observed between the eccentricities and periods of double stars. A discussion of the views

of C. K. Seyfert. From a discussion of additional data, the author can neither confirm nor deny the conclusion of the reality of this relation. RAYMOND LAURIÉ: The density and molecular constitution of a normal pure liquid. WOJCIECH SWIETOSLAWSKI and JOSEPH SALCEWICZ: The application of Newton's laws of cooling to the measurement of very small thermal effects. The method described has been applied to the determination of the heat produced by a specimen of pitchblende. The temperature change was of the order of 0·0034° per hour. EMILE SEVIN: Waves, spin and numbers. J. SAVARD: The ionisation potentials and energies of formation of some halogen molecules. JEAN SAVORNIN: The influence of the reflective power and sharpness of the edge of a screen on distant refraction. MLLE. C. CHAMIÉ: The supplementary radiations in the recoil of the active deposit of thorium. JULES GUÉRON: The Raman spectrum, constitution and evolution of solutions of stannic chloride. MLLE. MARIE LOUISE DELWAULLE: The system bismuth iodide, potassium iodide, water. PIERRE LOCUTY and PAUL LAFFITTE: The system sulphuric acid, ammonium sulphate, water. PICON: The preparation and properties of ammonium, calcium and quinine aurothiosulphates. A. PERRET and R. PERROT: The reactional aptitude of sodium amide. Study of the reactions of sodium amide with cyanogen, phosgene and sulphuryl chloride. CHARLES DUFRAISSE and MAURICE LOURY: Researches on the dissociable organic oxides. 1, 1-Diphenyl-3, 3-dicarbethoxyrubene. Its dissociable oxide. GEORGES DARZENS and ANDRÉ LÉVY: The fluorine derivatives of butyltoluene and of butyl-*m*-xylene. New fluoro-nitro derivatives smelling of musk. JACQUES FROMAGET: The Trias in the north-west part of the syncline of Sam Neua (Tonkin and Laos). P. ROUGERIE: The harmonic analysis of the diurnal variation of the north-south earth currents recorded at the Parc Saint-Maur Observatory. GEORGES DEFLANDRE: Microfossils of plankton origin, preserved in the state of organic matter in flints from the chalk. H. COLIN: The starch of the Florideæ. This has properties intermediate between those of true starch and glycogen. PIERRE LESAGE: The heredity of acquired precocity in *Lepidium sativum*. MLLE. JEANNE LÉVY: Experimental alcoholism. The mechanism of growing used to alcohol. From experiments on the rat it is concluded that there is no acceleration in the oxidation of the alcohol: the effect is due to a reduction in the sensibility of the cells of the brain. ANTOINE MAGNAN: Contribution to the study of flight in birds. MARC DE LARAMBERGUE: Self-fertilisation and cross-fertilisation in *Bullinus contortus*. P. CHEVEY: The vertical distribution of the ichthyological fauna near the eastern coasts of French Indo-China. JACQUES POCHON: The rôle of a cellulolytic bacterium of the stomach, in the transformation of cellulose into glucose, in the interior of the digestive tube of ruminants. It is proved that *Plectridium cellulolyticum* is an important factor in the process of digestion of cellulose in ruminants. GASTON RAMON: Experimental antidiphtheric immunisation by means of living diphtheria bacilli.

### CAPE TOWN

**Royal Society of South Africa, August 15.** R. W. S. CHEETHAM, I. SCHRIRE and H. ZWARENSTEIN: Influence of testicular and of urinary extracts on the creatinine excretion in rabbits. Testicular extract increases the excretion of creatinine transiently in the normal rabbit by approximately 40 per cent. Testicular suspensions decrease the creatinine elimination in the normal rabbit by approximately 40 per cent. This too is a transient effect. Injection of urinary extract of the male sex hormone first decreases the creatinine excretion by 30 per cent and then increases the elimination by 30 per cent approximately. This is a diphasic effect, and passes off within four days of the injection. B. G. SHAPIRO and H. ZWARENSTEIN: Effect of hypophysectomy and castration on muscle creatine in *Xenopus laevis*. The average creatine content of the hamstring muscles of the South African clawed toad is 400 mgm. per 100 gm. Removal of anterior or both lobes of the pituitary produces a steady decline in muscle creatine. Five months after operation the hypophysectomised animals contain an average of 18 per cent less creatine than the captive control animals. Removal of the testes or of the ovaries has no effect up to five months. S. HONIKMAN, H. A. SHAPIRO and H. ZWARENSTEIN: The bio-assay of the gonadokinetic principle of the anterior pituitary. A curve has been constructed relating dosage of an acid extract of anterior pituitary (sheep and goats) to percentage response (ovulation plus oviposition) in *Xenopus laevis* during July (breeding season). Fifty animals were used for each point: they were kept at 18°–20° C.; readings were taken twenty-four hours after injection; laboratory age of animals did not exceed two weeks. The unit is defined as the amount of original tissue required to produce a 50 per cent response. This was found to be 3·8 mgm., that is, 263 units per gram. BENJAMIN FARRINGTON. Vesalius on china-root. Extracts from a letter of Andreas Vesalius to Dominus Joachim Roelants written at Ratisbon, June 13, 1546. At this time China-root (that is, China-smilax, a species of sarsaparilla) had an enormous reputation as a specific for various diseases. Vesalius, in lively and sarcastic style, exposes the inadequacy of the basis on which this reputation rested.

### VIENNA

**Academy of Sciences, Oct. 25.** KARL GROBBEN: Decapod sperm and the position of Eucyphidea in the genealogical tree of the decapod Crustacea. JOSEF HARAND: Critical temperature as a microchemical characteristic. A heating block for the safe and rapid determination of critical temperatures is described. A streaming microscope is used which allows quantities of material as small as 0·1–0·05 mgm. to be employed. Prud'homme's formula for chlorine derivatives of the paraffin series is confirmed, the critical temperature of methane being calculated to be 186·6°. The values for *n*-, *i*-, and commercial butanes are given, and it is shown that a substance gaseous at the ordinary temperature may be identified and its purity determined by means of its critical temperature. Examination of binary systems is also possible. ALFRED PISCHINGER and WILLY HORNIK: Influence of indifferent neutral salts on substantive histological staining. OTTO SCHINDLER: The kidneys of the larvæ of sea fish.

**Oct. 31.** FRITZ RIEDER: Wilson chamber studies of the ultra-radiation on the Hafelekar (2,300 metres). With the help of Wilson diagrams, a statistics of the electrons liberated by ultra-radiation, as regards their energy and—with some degree of probability—the sign of their charge, is developed. Observations

were made also on heavy corpuscular rays, the liberation of which by ultra-radiation appears established; these have ranges of 0·6 cm. to at least 5·5 cm., calculated to 15° C. and 760 mm. pressure, but their nature and the mode of their formation remain unknown. FRIEDRICH LAUSCHER: Thermal radiation and restriction of horizon. Radiation of basins, valleys and lanes. (1) A general method for deducing the radiation from any surfaces.

## Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

### Saturday, December 15

BRITISH PSYCHOLOGICAL SOCIETY, at 3. Annual General Meeting.

### Sunday, December 16

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. A. Phillips: "Fossil Mammals".*

### Monday, December 17

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Dr. W. T. Calman: "The Shipworm".*

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Discussion on "Population Maps" to be opened by Prof. C. B. Fawcett.

### Tuesday, December 18

EUGENICS SOCIETY, at 5.15—(at the Linnean Society, Burlington House, W.1).—Dr. Shepherd Dawson: "Disease and Intelligence".

### Wednesday, December 19

BRITISH SCIENCE GUILD, at 5 (at the Royal Society of Arts, John Street, Adelphi, London, W.C.2). Col. M. O'Gorman: "Bringing Science into the Road Traffic Problem".

## Official Publications Received

### GREAT BRITAIN AND IRELAND

Department of Scientific and Industrial Research. Industrial Research Exhibit: a Guide to Stands 6 to 34, Cardiff Engineering Exhibition, 1934, under the auspices of the South Wales Institute of Engineers. Pp. 20. (London: Department of Scientific and Industrial Research.)

Proceedings of the Third International Locust Conference, London, September 18, 1934. (Cmd. 4725.) Pp. 184. (London: H.M. Stationery Office.) 3*s*. 6*d*. net.

Year Book of the University Catholic Societies Federation of Great Britain, 1934–1935. Pp. 96. (Glasgow: Hon. Secretary, 13 Fortrose Street.) 1*s*.

Rothamsted Experimental Station, Harpenden: Lawes Agricultural Trust. Report for 1933. Pp. 200. (Harpenden: Rothamsted Experimental Station.) 2*s*. 6*d*.

Natural Science and Archæology Society, Littlehampton. Reports of Proceedings, 1933. Pp. 22. (Littlehampton.)

Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year ended 31st March 1934; with Report of the Director of Fuel Research. Pp. vii+178. (London: H.M. Stationery Office.) 3*s*. net.

University of Durham. Abstracts of Theses for Doctorates presented by Candidates who have received the Degrees in Convocation during the Academical Year 1933–1934. Pp. 12. (Durham.)

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 1, No. 11: The Early Stages in the Development of the Ferret; Fertilisation to the Formation of the Prochordal Plate. By Dr. William J. Hamilton. Pp. 251–278+7 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 6*s*.

The Royal Technical College, Glasgow. Annual Report on the One Hundred and Thirty-eighth Session adopted at the Annual Meeting of Governors held on the 16th October 1934. Pp. 84. (Glasgow.)

The North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1933–34. Pp. 36. (Aberdeen.)

A Review of the Experimental Working of the Five Days Week by Boots Pure Drug Company at Nottingham. By Sir Richard A. S. Redmayne. Pp. 70. (Nottingham: Boots Pure Drug Co., Ltd.) 1*s*.

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 13: The Measurement of the Current generated by Rectifier Photo-Cells. By H. H. Poole and W. R. G. Atkins. Pp. 133–139. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

### OTHER COUNTRIES

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3399

SATURDAY, DECEMBER 22, 1934

No. 3399 Vol. 134

## CONTENTS


| | PAGE |
|---|---|
| Political Principles and Native Affairs in Africa | 949 |
| War by Poison. By Arthur Marshall | 952 |
| Resonance Radiation. By W. E. C. | 953 |
| Sir Robert Morant. By R. B. | 954 |
| Short Notices | 955 |
| Pyramid Prophecy. By Rupert Gleadow | 956 |
| Modern Street Lighting | 957 |
| Polarimetric Methods in Chemistry. By Prof. T. M. Lowry, C.B.E., F.R.S. | 958 |
| Obituary: | |
| Baron de Gerlache. By H. R. M. | 961 |
| Dr. N. E. Brown. By J. H. | 961 |
| News and Views | 962 |
| Letters to the Editor: | |
| The Lightning Flash as Source of an Atmospheric.—Prof. E. V. Appleton, F.R.S. and F. W. Chapman | 968 |
| The Mass of the Neutron.—Prof. William D. Harkins and Dr. David M. Gans | 968 |
| The 1933 Everest Climbing Expedition and Oxygen.—Sir Leonard Hill, F.R.S. | 969 |
| Experiments on the Fermi Effect.—M. Danysz, J. Rotblat, Prof. L. Wertenstein and M. Zyw | 970 |
| Use of Phosphomolybdic Acid in Chemical Analysis.—J. W. Illingworth and J. A. Santos | 971 |
| Oxygen Preparation from Sodium Peroxide.—G. H. Cheesman and D. R. Duncan | 971 |
| Chemical Linkage.—Prof. R. F. Hunter and Prof. R. Samuel | 971 |
| Power in Social Psychology.—H. G. Wells; Prof. H. Levy | 972 |
| Relationship of Soils to Manganese Deficiency of Plants.—G. W. Leeper | 972 |
| Publication of *Nomina Nuda*.—Sir Sidney Harmer, K.B.E., F.R.S. | 973 |
| Design of Theodolite Axes.—F. S. Richards; Prof. A. F. C. Pollard | 973 |
| The New Star in Hercules.—Prof. F. J. M. Stratton | 974 |
| Red 'Water-Bloom' in Iceland Seas.—Prof. Ove Paulsen | 974 |
| Research Items | 975 |
| Chromosome Behaviour in Terms of Protein Pattern. By Dr. D. M. Wrinch | 978 |
| Brood Diseases of Bees. By A. D. I. | 979 |
| Sleep and Hypnosis | 980 |
| Mechanisms of Cellular Respiration | 980 |
| University and Educational Intelligence | 981 |
| Science News a Century Ago | 981 |
| Societies and Academies | 982 |
| Forthcoming Events | 984 |
| Official Publications Received | 984 |


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## Political Principles and Native Affairs in Africa

DURING his recent visit to England, General Smuts, by his utterances on matters of public policy, did much to enhance a reputation which already stood high. His philosophical breadth of view and his appreciation of the gravity of the issues which need to be faced, whether he dealt with the affairs of South Africa or surveyed the situation in the world at large in relation to imperial policy, assured his position as a protagonist in any future reasoned approach to the solution of the ills of modern civilisation. If, therefore, his views on certain questions are made the occasion of comment in relation to the application of scientific principles to problems of government with which he is concerned, it cannot be imputed to him as a fault that his outlook is that of a party politician. None the less it is essential to remember that General Smuts, like other leaders in a modern democracy, must work through the medium of party machinery.

This limitation cannot be ignored in matters affecting, or affected by, the position of the native population of South Africa. Whereas in a crown colony or protectorate difficulties and problems of native life can be made the subject of impartial scientific inquiry and settled by administrative action, in the Union of South Africa they may be, and almost invariably are, brought into the heated atmosphere of everyday politics, since in some form or other in a population in which black outnumbers white by something like three to one, the native question is near to all.

The history of the native question in South Africa is largely a history of party conflict; and even now it is only slowly and partially that the results of scientific inquiry are being applied to the amelioration of conditions brought about by indifference to the study of native institutions. This renders it all the more gratifying that General Smuts should have been in a position to announce that measures are in prospect for the improvement of conditions of native life, and more particularly, that additions may be made to their lands. This last, indeed, is an urgent necessity, for which those best acquainted with native institutions and conditions have long pressed in order that the ethos of native communal life might not be denied the opportunity of full expression.

On the other hand, when General Smuts presses for the transfer to the Union of the

Protectorates of Bechuanaland, Basutoland and Swaziland, the relation of the native question to political feeling within the Union may well give pause, lest a too hasty assent be given to the transfer to a Dominion Government of native peoples who have placed themselves voluntarily under imperial jurisdiction. To suggest this is in no sense to impugn the good faith of the people of South Africa ; but where the sense of the colour bar is strong, and is reinforced by an economic competition which is bound to increase, it must inevitably be difficult to ensure that it will not affect administration, even when the position and interests of the voter are not directly implicated.

On the other hand, it might be contended that the trend of native legislation in South Africa is reassuring. From 1927 it has secured throughout the four provinces of the Union the unification of principle in native administration, establishing on a firm basis respect for native institutions and the social codes of those natives who live under the tribal system ; and it aims at the principle of the complete segregation of black and white—in which it has the firm support of the more advanced element in the native community. Thus it may be maintained that it provides a sufficient guarantee that the administration of the Protectorates will be no less sympathetic under the Union than it has been under the Imperial Government.

In so far as concerns the preservation of the *status quo* in the Protectorates, there can be no question that this argument carries weight. Yet there are those who, looking at the facts within the Union with the eye of impartial inquiry, point out that the policy of segregation in a practical sense is inoperative; and further, that it does not as a matter of fact provide that opportunity for the development of the native within the framework of his own tribal institutions, even though these may be modified or adapted in such a way as to train him to become a participating member in the community, which was anticipated by those who first advocated this policy.

In Africa, if anywhere, it is necessary to take long views, and neither the system of reserves for the tribalised native, nor the regulation of the detribalised population took full account of the effect which would follow from the existence of a large urbanised native and coloured element in active economic competition with the lower grade of white labour. The policy of segregation has restricted, rather then fostered, native development in certain directions. Such, for example, is the effect of legislation confining to the reserves the holding of land by natives. This has put an end to the advantageous practice of farming out the land by land-owners to native squatters on a crop-sharing basis, and in some areas has now affected adversely the amount of land under cultivation. It has also checked manual training, from which at one time much was hoped for the material and intellectual development of the native. Natives returning to the reserves can find no opportunity in tribal culture for the exercise of the skill they have acquired and, consequently, have ceased to interest themselves. Schoolmastering and the ministry virtually afford the only prospect of advancement, and here the opportunities are necessarily limited.

It may, however, be asked, to what conclusion does this tend ? Admitted, it may be said, that the present position of the native within the Union is the outcome of racial conflict, both white and black races are intruders, and the Bantu have been in the country very little longer than the white man. If, therefore, we regard, as we must, the interests of a white South Africa as necessarily prevailing, this need not affect the very different conditions upon which the Protectorates will come into the Union. The answer to this contention must be that it is not sufficient that the *status quo* should be maintained. No action must be taken which in any way may prejudice the opportunity for dispassionate discussion of the lines along which the native tribes of the Protectorates may be assisted towards their future standing, whatever that may be. In present conditions their future is a part of the problem of black Africa as a whole, and its discussion lies outside the range of local political theory or prejudice. Can the same assurance be given by the Union ?

The future of Africa is bound up with the fate of her native populations. A proposition so crudely obvious would seem scarcely worth statement, if it were not for the fact that it cannot be too strongly emphasised to enforce the corollary that the problem of the future of the African peoples cannot be solved without the application of the results of intensive scientific study. That contact with European civilisation everywhere is rapidly affecting native cultures and organisation is obvious ; yet apart from certain private or semi-private efforts, no systematic attempt is being made to ascertain its mode or direction, or whether in the long run, if unchecked, it will

prove permanently harmful to the well-being of Africa as a whole. Only a few weeks ago it was felt necessary to direct attention in the columns of NATURE (Oct. 20, p. 585) to the urgency of an appeal from men of science and others in the daily Press to secure public interest in expenditure, small in relation to the importance of its object, upon an investigation of the mentality of the African native—an investigation by the results of which the whole future policy of native education and training may be fundamentally affected.

The proposed investigation of the mentality of the African natives was coupled with a suggestion for an inquiry into their pathology and hygiene. The urgency of the medical problem is so patent that it has overshadowed the no less urgent significance of the more purely anthropological investigation. For, as Sir Grafton Elliot Smith has pointed out, this latter is no more than a preliminary inquiry. It is, however, imperative that it should be undertaken, before it is possible to enter upon the consideration of the wider question of the interaction of the changing African and his changing environment, and the modifications in political and social organisation which that interaction must entail.

It is usual to assume—or, at least, in relation to the proposed inquiry, it has been assumed and asserted—that the African is of inferior or backward mental character. To many, however, this seems an open question, to which the inquiry, it is hoped, will reveal the full answer. In part the assertion seems to be contradicted by many well-attested facts, but for the moment discussion may be set aside. What is important to note is the fact that, so far as the anthropologist is concerned, the scientific line of approach recognises differences in culture as the product of racial history and environment without attempting to evaluate them in terms of a higher or lower mentality. Each is the adaptation best fitted to its conditions in so far as it successfully conduces to survival. For the politician, however, cultures are apt to be graded as 'higher' or 'lower' and translated into terms of race as 'superior' and 'inferior', these terms carrying with them the implication that the 'superior' race is justified in assuming control of the 'inferior'. Hence 'racial problems' and the attempts, of which the results deserve careful study, to convert the native African into a dark-skinned European, with consequences which have been far from happy, as may be seen in our older African colonies.

It is the merit of the system of 'indirect rule', and of the modifications of it which have been applied in our African dependencies, other than those of West Africa, that it has recognised differences of culture and race in the contact of African and European, and except in certain specific matters, has as a matter of principle admitted the suitability of African culture for the African at his present stage of development. It is a strange commentary on our attitude in the past to 'backward' peoples that this should not be obvious.

The special significance of the proposed inquiry into the mentality of the African is that it comes at a moment when it is becoming increasingly apparent that 'indirect rule', the reserve system and other measures of a like character, are a 'half-way house' in which the native may live for a considerable length of time, but which eventually must be evacuated. Administrative action, working with justice and sympathy, may retard that evacuation; it may dissipate the shock of social and moral dislocation inevitable as a concomitant of the change; it cannot avert it indefinitely. Whether it is to be a halfway house on the road to degradation or virtual extinction as has happened to most of the American Indians, or to a fuller development of the best of African culture in alliance with that of the white races, is a grave responsibility which rests upon those by whom the future of the African will be shaped.

In seeking the direction in which this future lies, and in estimating the trend of changing conditions in Africa, due weight must be given to the volume and direction of native opinion, which is becoming increasingly articulate at the same time as it grows in force and precision. Africa is no longer entirely plastic in the hands of the administrator. Yet both in South Africa, in the support given to segregation, and in West Africa, where the native critic tends to regard 'indirect rule' as a means adopted by the white man to keep the black man in his place, native opinion is averse from the preservation of native custom as merely static. Whether, with its co-operation, the administration may be able to foster the development of a distinctive African culture, which has absorbed such elements of European civilisation as will ensure survival, for the time being must rest on the knees of the gods. It will demand efforts strenuous and long enduring, and no less scientifically planned.

## War by Poison

*"Gas!" : the Story of the Special Brigade.* By Major-General C. H. Foulkes. Pp. xv+361+16 plates. (Edinburgh and London: William Blackwood and Sons, Ltd., 1934.) 30*s.* net.

THE use of 'gas' in war has been defended by several British and American writers on the ground that it is less inhumane than bullets and high explosives. It is pointed out that in the last years of the War, only about 3 per cent of the gas casualties of the Allies died, and the great bulk of the remaining 97 per cent made complete recoveries in a short time. General Foulkes advocates it on quite other grounds: if properly applied, he says, it causes far more casualties than any other arm, and the deaths amount to 20–40 per cent of the casualties. Consequently it offers the best means of ending a war that is settling down to a condition of protracted siege.

This great discrepancy in the mortality is due to different methods of using gas. At first, in April and May 1915, the Germans used clouds of chlorine released from cylinders installed in their trenches. They did not use them again on the British front until December because the prevailing wind was against them, but later in 1916 they made four more cloud attacks. Although the British troops were then provided with gas masks, the casualties averaged 876 in each attack, with a mortality of 24 per cent. Yet the Germans then discontinued this method, and used only shells, which caused very few casualties and scarcely any fatalities, until mustard gas was introduced.

Why did the Germans give up such an effective method? The troops disliked it, as it involved heavy labour in bringing up and installing the cylinders, and it inevitably subjected them to artillery retaliation. Then they had to wait an indefinite time, perhaps months, for a favourable wind of the right strength, and sometimes, even then, it veered round and blew the gas on to themselves. As the cloud attacks were seldom followed up, their effects were unknown, at any rate until long afterwards. The most important reason, however, was that in September and October 1915, the British replied with cloud gas attacks at Loos and the Hohenzollern Redoubt with considerable effect. The German High Command then realised that a mistake had been made in introducing this weapon on the Western Front, where the prevailing wind was against them, and in order to discourage us from continuing its use, they stopped it and suppressed all references to gas casualties in their own ranks.

From July 1916 until July 1917, the Germans fired great numbers of shells filled with non-persistent liquids, either lachrymatory (xylyl bromide, for example) or lethal (diphosgene). Neither of them caused many casualties, and the mortality was only 6 per cent, but they had some tactical value, because they forced our troops to wear their masks or drove them into the dug-outs. Then the Germans began to use mustard gas (dichlorodiethyl sulphide) and the British casualties increased enormously, but the mortality amongst them fell further to 2·5 per cent. Except the first unexpected attacks with chlorine gas, this was undoubtedly by far the most successful of the substances used by the Germans, because it affected the whole body, and persisted for a long time in consequence of its low volatility and the very small concentration that sufficed to produce casualties.

In July 1917 the Germans also began to use shells charged with a 'sternutator', diphenylchloroarsine, which, in the form of a cloud of minute particles, produces running at the eyes, coughing and especially sneezing so severe that it may render it impossible to wear a gas-mask. As the particles have no Brownian movement and the substance is a practically non-volatile solid, it is only partly removed from the air by the activated charcoal of the respirator, but fortunately the British had had warning, and consequently added a layer of cheese-cloth to the box respirator, and this filtered out the particles. The high explosive used in the German shells to reduce the substance to a particulate cloud was not effective; the particles were too large. An officer of the British gas service discovered that it is far better to volatilise it by heat, and this led to the idea of a thermogenerator in the form of a sort of smoke candle, or contained in a shell. If the War had lasted until 1919, it was intended to use them on a very large scale charged with the even more potent compound, diphenylaminechloroarsine.

The evolution of gas tactics in the British Army followed rather a different course. The Special Brigade, consisting largely of men with chemical training, showed great enterprise and initiative, but was hampered at first by the breakdown of the British system of supply by contractors. As there were not enough shells for high explosive and shrapnel, naturally not many could be obtained for gas filling, so the Brigade continued to use clouds of chlorine and afterwards of phosgene ($COCl_2$), which is much more lethal. Then the Stokes mortar was introduced, and as this fired a thin-walled shell and had a very rapid rate of fire, it was very suitable for producing the required high concentration of gas. In 1917 the Livens projector came into use, and this fired a thin-walled drum containing 30 lb. of phosgene. As the projector consisted simply of a solid drawn steel

tube ¼ in. thick, it could readily be manufactured in large quantities. A large number of them were simply buried in the ground up to their muzzles and fired simultaneously by electricity. Thus a high concentration was suddenly and unexpectedly generated in the enemy trenches, and the casualties and fatalities were severe. The Germans also adopted the projector, but they failed to understand that the drums must be of large capacity and that they must be used in large numbers in a limited area.

In the British service, the technique of the gas cloud was improved by the introduction of the 'retired cylinder' method of attack. The inconvenience and danger of installing the cylinders in the front line trenches were avoided by placing them some 600 yards to the rear, either in trucks on a light railway, or carefully camouflaged. As the clouds penetrated with the wind to a depth of 12 miles or more, this did not interfere with the effectiveness, but it was of course necessary to withdraw our troops for a time from the trenches in front of the cylinders. This device was to have been tried on a very large scale in 1918, but was prevented first by the German attack in March, and afterwards by the advance of the Allies, which did not allow of the necessary arrangements being made. Nevertheless, a number of smaller gas attacks of this sort were made, and appear to have been very successful.

This is the best book that has been published on gas warfare. It does not profess to deal fully with the chemistry, physics or physiology, but it does discuss at considerable length the tactics of gas attacks, which is of fundamental importance. Much of the matter has not appeared before, and the book is illustrated not only by numerous photographs but also by maps of the Western Front prepared by the Ordnance Survey. General Foulkes, as Director of Gas Services, was able to collect information about the German gas casualties which throws an entirely new light on the subject. It is evident, however, that he is less interested in defence, and although he mentions the various types of gas-mask that were used during the War, he makes no allusion to the great improvement that has been effected since 1918. The present mask of moulded rubber is so comfortable that it can be worn indefinitely without diminishing seriously the fighting value of the troops, and this must have a great effect on the gas warfare of the future.

In his enthusiasm, General Foulkes is inclined occasionally to forget the limitations of gas warfare. After the Armistice he went to India to advise the Government there, and to study the possibilities of gas in frontier fighting. He says: "Here, of course, gas would be particularly valuable, as the fighting consists largely of a struggle for hill-tops, the evacuation of which can be forced by a very small expenditure of gas ammunition." Surely a bare, rocky hill-top under a scorching sun is very unsuitable for the production of that high concentration of gas upon which the author insists.

General Foulkes discusses somewhat briefly possible gas attacks upon the civil population in future wars. He says: "While fully admitting the grave dangers to cities of attacks from the air I do not believe that gas in bombs or in the form of spray would inflict anything like as much loss of life as H.E. . . . I might point out that the conditions in a town are very different from those on the battlefield: houses, for instance, if their occupants are taught to use them properly, can be made tolerably safe places of refuge against gas [for some further information on this, see J. Davidson Pratt, *Chemistry and Industry*, Oct. 19, 1934], whereas they increase the effect of H.E. owing to the danger of falling masonry and outbreaks of fire." Everyone who has really studied the matter will probably agree with this statement.

"Is it worth it?" is the question which Field-Marshal Lord Cavan asks in the introduction, but this raises the further question: Is gas warfare really worse than war by high explosive, or even than fighting with sword and spear on the same scale? What we have to abolish upon our developing globe is war, not war by poison.

ARTHUR MARSHALL.

## Resonance Radiation

*Resonance Radiation and Excited Atoms.* By Prof. Allan C. G. Mitchell and Prof. Mark W. Zemansky. (Cambridge Series of Physical Chemistry.) Pp. xvi+338. (Cambridge: At the University Press, 1934.) 18*s.* net.

THE fundamental phenomenon with which this book is concerned, namely the re-emission of absorbed radiation without change of wave-length, would appear to be one of the simplest of atomic processes. No doubt it is, but before reliable information regarding the individual atom can be obtained from the observations, a great many difficulties, both experimental and theoretical, have to be overcome. For example, since the results are largely dependent on the intensity distribution of the existing radiation, a suitable source, satisfying certain rather exacting requirements, is essential. The pressure of the absorbing gas is another important factor. If this is too high, complications arise owing to atomic collisions and re-absorption of the resonance radiation. If, on the other hand, it is too low, the resonance radiation will be too weak to observe.

The existence of metastable levels, the presence of foreign gas, the hyperfine structure of the levels and the influence of magnetic and electric fields are other factors of which account may have to be taken.

A great deal of experimental work has been done in this field, but in view of the difficulty of interpreting the observations, it is not surprising that some of the results have been inconclusive and even mutually contradictory. Progress has undoubtedly been hampered also by the lack of any comprehensive survey of the subject and by diversity of notations. The present volume appears therefore most opportunely and meets the requirements of the situation in an altogether admirable manner. The authors are both active and successful research workers, and their treatment of the subject is authoritative and critical. It is also comprehensive, ranging over such a variety of topics as to preclude even a mere enumeration of them in a brief notice. Some idea of the kind of problem discussed may be obtained, however, by reference to a few of the more important, such as, for example, the contours of absorption lines, methods of estimating life times of excited atoms, phenomena associated with atomic collisions, and the polarisation of resonance radiation.

The presentation is interesting and lucid. Each chapter is provided with a bibliography, and there are thirteen appendices containing mathematical derivations and tables. The index appears adequate and a careful scrutiny failed to disclose more than two very trivial misprints. The authors are to be congratulated upon the conspicuous success of their undertaking; they have not only produced a valuable record of scientific achievement but in addition have ordered and systematised the subject in a manner which will be of the greatest assistance to future endeavour. W. E. C.

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## Sir Robert Morant

*Sir Robert Morant, a Great Public Servant.* By Dr. Bernard M. Allen. Pp. ix+318+4 plates. (London: Macmillan and Co., Ltd., 1934.) 12*s.* 6*d.* net.

ENGLAND has known that in Morant she had a great public servant, but how large had been his contribution, towards legislation and through administration, to the progressive development of the social services of education and public health was scarcely known beyond his intimate friends and colleagues and keenest critics.

Dr. Allen tells the story in four chapters of quiet and attractive language and judicious appreciation without apparent restraint or exaggeration, trusting to the cumulative effect to give a full picture of his subject. Each chapter records great achievement but ends in disaster. In Morant we see no trained disciple, but one of Nature's giants endowed with the sentiments and zeal of a missionary, and the steel of his character edged on the rough grindstone of hard circumstances and passionate opposition. The first is a fascinating chapter of boyhood and youth at Winchester and Oxford; of straitened means; of a young man on whom the shadows of life were already making an indelible impression and inciting to high endeavour, and of the fading away of cherished hopes of social service through the Church of England.

"Siam" is less attractive but none the less necessary. Although the chapter closes with the temporary crushing of Morant's spirit, his responsibilities, his insight into the 'perplexities and confusions' of high policy in a troubled State, the jealousy which at length gathered round him, and above all his isolation, seem a preparation, better than he could know, for the gigantic task that was maturing for him at home—a strengthening of his natural capacity to stand alone against tremendous odds.

Morant sought and obtained a humble post in the Education Department. Within seven years he became the permanent head. With dynamic energy he had thrown himself into the confused situation, mastered the facts, made his knowledge and power indispensable to ministers promoting legislation and settled his own mind as to what England needed. He urged the necessity of an expert central authority for the whole of our educational system, and localised "guidance of brains" (the local education authorities) to watch, consider and advise upon educational arrangements of all grades and of every type. In his brilliant fight for legislative authority for these latter objects and to save the non-provided schools, Mr. Balfour and his powerful adviser drew on themselves the opposition of almost the whole Liberal party, of the forces of Dissent and of the resisting school boards and their supporters, concentrated in the House of Commons in another great Parliamentary fighter—Mr. Lloyd George. But they succeeded, though not perhaps to their entire satisfaction.

In administration it was the same—boundless energy and new lines of development. The occasion of a slip, however (the Holmes Circular), gave his opponents their chance and they brought him down. Morant was transferred to the Local Government Board and by the whirligig of circumstances found himself the formidable adviser of the outstanding opponent of the Education Bill, who was reconstituting the service of public health. But he had spent his wonderful energy and succumbed to a swift attack of septic pneumonia.

Morant's mistakes have no part in the lasting influence of his great services. R. B.

## Short Notices

*Bentley and Driver's Text-Book of Pharmaceutical Chemistry.* Revised by Dr. J. E. Driver. Second edition. Pp. xv+538. (London: Oxford University Press, 1933.) 16*s.* net.

THE second edition of this book was rendered necessary by the publication of the 1932 "Pharmacopœia", and is a great improvement on the first edition. The book consists of an introduction, a section on analytical methods, one on inorganic compounds, one on organic compounds and an appendix.

The best two chapters in the book, in the section on analytical methods, are those written by Dr. Prideaux and dealing with hydrogen ion concentration and the methods for determining it. It is not often that this subject is dealt with in such a clear and lucid manner. In the description of the methods of analysis of carbon compounds there are one or two omissions. No mention is made of accelerators for the Kjeldahl method for nitrogen and the only method described for halogens is that of Carius, though the "British Pharmacopœia" uses the method of Piria and Schiff for trichloracetic acid.

The reviewer has found that students of pharmacy have generally a limited knowledge of organic chemistry, and to the majority of them this is the most difficult part of pharmaceutical chemistry. One of the stumbling blocks is the correct understanding of the ethylenic linkage, for unless this is very carefully explained, they imagine it to be a strong point, instead of a weak one in a chain of carbon atoms. It would have been a great help if a short description of Baeyer's strain theory could have been incorporated in the chapter dealing with unsaturated hydrocarbons.

The chapter on glucosides contains no reference to the digitalis group or to the newer term 'glycosides'. The article on vitamins gives a fairly good idea of the present position regarding these substances, but implies that the sterols are the only unsaponifiable alcohols. Bibliographical references are given at the foot of each page and these should prove useful to those students desiring further information. The illustrations are numerous and for the most part useful.

It is stated in the preface that the book is a text-book for those studying for the examinations in pharmaceutical chemistry of the Pharmaceutical Society and similar examinations. As such it fulfils its mission. S. G. S.

*Erinnerungen: Bekenntnisse und Betrachtungen.* Von Gottlieb Haberlandt. Pp. vii+243. (Berlin: Julius Springer, 1933.) 10.80 gold marks.

THIS little book, as its sub-title suggests, comments in fresh and lively fashion upon the topics that pass inevitably in review in these reminiscences of eighty years spent largely in the service of botany in Germany. They thus reveal in pleasant fashion the striking personality of its author, who is best known in England as the author of "Physiological Plant Anatomy".

It is amusing thus to learn that Haberlandt became a botanist in the first place because the external appearance of Julius Wiesner's college in Vienna for the study of anatomy and physiology of plants was more attractive than that of the college in which studies of German language and literature were proceeding, and secondly because the necessary dissection made the study of structure in the animal world less congenial. In his early days, the great textbook of Sachs makes the strongest impression, but the young doctor does not go to Würzburg but to Schwendener at Tübingen, whose monograph upon the mechanical principle in the anatomical structure of Monocotyledons has just appeared. Thus early is made the link between structure and functional performance, and this line of thought is developed after Schwendener's removal to Berlin, during years as *Privatdocent* first at Vienna and then at Graz. Here appeared the "Physiological Plant Anatomy" upon which Haberlandt's fame largely rests, though with his transference to Berlin in 1910 as successor to Schwendener, a second period of activity began in which developmental physiology was more prominent. To this period belong the studies of the physiology of cell division which are still profoundly influencing botanical development, though his early suggestion of contributory 'hormones' is now giving way to less definite suggestions of 'growth substances', of which the Utrecht school would restrict the influence to an effect upon cell extension.

Many a botanical reader outside Germany will be grateful for the opportunity thus presented to share, even in this one sided way, in a discussion with Haberlandt of topics which remain of perennial interest wherever botanists are gathered together.

*Field Studies in Ecology.* By Dr. R. Bracher. Pp. 100. (Bristol and London: J. W. Arrowsmith, Ltd., 1934.) 2*s.* 6*d.* net.

THIS little book on practical work in connexion with plant ecology will be found very useful alike to students and to teachers of botany. Her experience in conducting field work in connexion with the University of Bristol has enabled the author to condense in a small compass all that is essential in a practical study of ecological problems. This she sets forth in a clear and concise manner, with suitable illustrations and with practical hints on methods of investigation, on mapping and on determining the various factors which influence the vegetation: light, atmospheric and soil moisture, acidity or alkalinity of the substratum. The synopsis of British plant communities in the earlier part of the volume is exceedingly well arranged and cannot fail to give the student a very clear account of the various plant communities and their constituent plants. The book can be warmly recommended to prospective students of ecology both in schools and at the universities as a handy guide to their practical studies.

## Pyramid Prophecy

IT is now ten years since Mr. David Davidson published his first book on prophecy made from the measurements of the Great Pyramid of Gizeh. That book is now in its fifth edition, and has been followed by eight smaller publications, all of which have been given wide publicity in the public Press, through full-page advertisements and otherwise.

The latest pamphlet, a quarto of seventy pages, is entitled "The Hidden Truth in Myth and Ritual and in the Common Culture Pattern of Ancient Metrology" (Leeds: The Author, 47 Park Square; London: Williams and Norgate, Ltd., 1934. 2*s*. 6*d*.); and metrologically the chief contention is that the various systems of measures in the ancient world were all derived from one system invented "to form a standard basis of reference for the many loosely formulated primitive systems of measures". If this were the case it is an important discovery. But unfortunately we stumble immediately against an astonishing series of statements, such as the following: "Surely, however, a 'widespread . . . diffusion of customs and institutions' necessarily implies widespread commercial intercourse; and does not the latter postulate the need for a standard system of measures as a common basis for exchange and barter?" It seems strange that such a sentence could ever have been written in a world where the pound and the dollar fluctuate as they do, and the metric system has not yet been adopted by the English-speaking countries.

The essential point is that all primitive measures were based on a 'primitive inch' invented by Mr. Davidson and equal in length to 1·0011 British inch. The method by which this is proved is interesting. A passage in Horapollo ("Hieroglyphics", 1, 5) reads: "To represent the current year they (i.e., the Egyptians) depict the fourth part of an aroura; now the aroura is a measure of land of an hundred cubits. And when they would express a year they say a quarter." Mr. Davidson states that the reason why the quarter-aroura represented the year was that its circumference, if circular, would be equal to 3652·42 of the primitive inches which he has invented. This is taken to prove the existence of the primitive inch; and Sir Flinders Petrie is rebuked in heavy type for refusing to believe it.

Actually, however, Mr. Davidson is demonstrably wrong. The meaning of the passage in Horapollo is this: The Egyptian word for the quarter-aroura is *ḥsb*; and in classical Egyptian the word for the current year is spelt *ḥa·t-sp*, where *a* represents alif, and *t* is the feminine ending which was dropped in pronunciation in the third millennium. This word *ḥa·t* occurs in Coptic as *ha-* or *hi-*. Horapollo plainly means that in his time the two words *ḥsb* and *ḥa·t-sp* were pronounced the same; and all exponents of Egyptian morphology will support this explanation.

The point, however, on which Mr. Davidson lays greatest stress is the pyramid's "Displacement Factor". This is derived from his theory (for which there is no evidence) that the pyramid in building fell short of its intended measurements, by an error. Of the most accurately built ancient building in the whole world this is impossible to believe. It is further stated that in consequence of this error the pyramid was left incomplete at its top platform, as it was found that the apex-pyramid or cap-piece was too big to fit. There is, of course, no evidence of the existence of this cap-piece; and it is incredible that Khufu would have left his pyramid incomplete because the original cap-piece did not fit. He would simply have ordered a new one.

The error is said to have happened thus. Fairly early in building, the few casing-blocks that survive were laid in the middle of each side to guide the workmen. Of those that were added later, and have perished, Mr. Davidson says that they tapered until at the corners they were only half the correct thickness. Now this could never have happened by mistake; for the stones would not have fitted unless they were specially graduated; and that it did not happen has been shown by Sir Flinders Petrie ("Pyramids and Temples of Gizeh", p. 84): "On all the casing, and on the core on which the casing fitted, there are lines drawn on the horizontal surfaces, showing where each stone was to be placed on the one below it. If the stones were merely trimmed to fit each other as the building went on, there would be no need to have so carefully marked the place of each block in this particular way." These points, with the corner sockets, prove that the casing was deliberately planned and there can have been no error. The "Displacement Factor" therefore falls to the ground.

Naturally we begin to ask: Why should the Great Pyramid demonstrate the fate of Britain and the Lost Tribes when it has no connexion with either? Mr. Davidson makes the connexion by inventing "Proto-Hebrews" who are said to have instructed the Egyptians in the building. There is no evidence for them; but that does not, of course, influence the belief of Mr. Davidson and his followers in them.

Anyone who may still wonder whether Mr. Davidson's book actually explains a divine revelation should open the volume at random; he will find endless numerological jugglings and fictitious lines drawn in the pyramid. What Divine Being ever conceived descended to such puerilities? Truth, on the other hand, is known by its simplicity. For Christians the Bible is good enough, without seeking for guidance in the structure of the Great Pyramid. But since Mr. Davidson quotes from the Bible in support of his theories, it is quite fair to quote against him from St. Mark's Gospel, xiii, 22: "For there shall arise false Christs and false prophets, and shall shew signs and wonders, that they may lead astray, if possible, the elect."

RUPERT GLEADOW.

## Modern Street Lighting

IN his presidential address to the Junior Institution of Engineers delivered on December 14, Mr. C. C. Paterson chose as his subject "Modern Street Lighting", laying stress on the necessity of making roads safe for traffic. It is important to remember that the number of licensed road vehicles in Great Britain has more than doubled during the last ten years. Even with the reduced maximum speed of 30 miles an hour in street lighted areas, good illumination is required for safe driving during night time. The great source of danger is that the eye has to function in conditions in which there is so little light. The eye sees by contrast either of colour or brightness. If everything were of the same colour and uniformly bright, and the visibility of the atmosphere were perfect, it would be impossible to distinguish objects from their backgrounds as there would be no contrast.

The illumination produced by bright sunshine is of the order of 8,000 foot-candles. On an overcast day, daylight falls from about 700 f.c. to 100 f.c. just before dusk. About half an hour after the sun sets, the illumination is about 5 f.c. At this point a number of drivers switch on their lights, and about ten minutes later when the illumination is 2 f.c. about 60 per cent of the cars have their lights on. When the illumination falls to 1 f.c. seeing is bad and car sidelights are beginning to glare. As the light falls to 0·1 f.c. the contrasts which give such good discrimination in full daylight are very slight, and the elements of the retina which give us the sensation of colour are weakening in their action. A man with a brown jacket and grey trousers now appears to have clothes of a uniform dark colour, but we are unable to say what colour it is. The dark grey lorry which can be seen clearly by daylight against a somewhat lighter grey road surface now disappears, as the contrast is not sufficient.

The problem of good street lighting is to find how to make the contrasts sufficiently distinct. For good seeing, the maxim is to make contrasts as distinct as possible, and this leads to the simple rule "make the road surface as bright as possible". Street lamps from this point of view should not be designed to light up objects on the road, but the road itself. Objects on the street are usually seen as dark things against a bright background, and this is the effect which street lighting should enhance. It is often true that when we drive behind a motor headlight, we see because its horizontal beam lights up the object itself rather than the road. But this projector beam is 20–30 thousand foot-candles, which is many times greater than would be possible under good street lighting conditions. For general street lighting, it would, taking expense into account, be impossible to make the objects brighter than the street.

The first step towards improving lighting is to make the road form a light background by means of its polish or shiny nature. Light can be directed on to the road in such a way that it reflects like a mirror. It does this when the light is directed along the road instead of on it. It is surprising what unpromising materials reflect light in this way. An asphalt road surface well polished by traffic reflects light excellently. A rough non-skid road surface does so also in a less degree. It is the same kind of effect as that produced by the moon when it shines towards us over water. Fortunately, as roads are at present surfaced, the conditions are often ideal for securing an uninterrupted bright path of light along their whole length. For an expenditure of three watts per foot run of road, we can obtain an illumination of 0·5 f.c. as seen on a white surface.

The two guiding principles used in modern street lighting are increasing the road brightness by specular (mirror) reflexion and increasing it by diffuse reflexion. The modern designer uses street illumination only as a rough guide to find the total amount of light available in the street. It is little use to specify road lighting by means of the 'minimum' illumination produced. Judging, as is usually done, the relative merits of two systems of lighting by the 'minimum' illumination produced is sometimes quite misleading. The real criterion is to find out which yields the highest road brightness with a given street surface condition.

If a road is so wet as to be like a still sheet of

water, very little light is diffused, the chief road brightness coming apparently from the image of the lamp. So far, means have not been found of rendering visibility anything like as good under wet as under dry conditions.

The use of a large quantity of light merely to claim compliance with a higher class of specification of the British Standards Institution without ensuring that it gives a proportionally higher road brightness is wasteful. Competition in illumination is useless, but competition in road brightness is of real value and importance. However, it is inadvisable to skimp the light and reduce its amount to the minimum required for the road surface. A certain amount of light on buildings and fences makes a great difference to the appearance of the lighting effect and sometimes aids visibility.

Mr. Paterson's address contains much novel matter, and it looks as if our ideas on street lighting would be considerably modified in the next few years. To all who drive motor-cars or ride bicycles, a good road brightness is essential as safety depends on it. Only in this way can we safely eliminate the use of headlights and the risky situations which arise from their use on busy roads.

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## Polarimetric Methods in Chemistry*

By PROF. T. M. LOWRY, C.B.E., F.R.S.

### ARREST OF MUTAROTATION

FURTHER fortuitous observations showed that the mutarotation of nitrocamphor is not an independent intramolecular process, but depends on extramolecular circumstances, since under favourable conditions it may be arrested more or less completely over a period of several days. This discovery (which was made more than twenty years before Kurt Meyer's experiments on the aseptic distillation of ethyl acetoacetate in alkali-free vessels of silica glass) was also the result of a fortunate accident. The mutarotation of a solution of nitrocamphor in chloroform had been followed to completion during a period of about eight days, but had been accompanied by some loss of solvent (and possible concentration of the solution) by evaporation. The remainder of the solution had been left in the small graduated flask in which it had been prepared, and there was no reason to suspect that it would behave in any respect differently from the sample in the polarimeter tube. It was therefore a great surprise when, at the end of seventeen days, on attempting to confirm the *final* reading, it was found that the residue in the flask gave a rotation almost identical with the *initial* reading recorded more than a fortnight before. The transfer of the solution to the polarimeter tube, however, sufficed to initiate the mutarotation, which then proceeded with the same velocity as before.

Nearly ten years later, a further series of experiments was being made on the catalysis of mutarotation by acids and bases. It was then observed that solutions of nitrocamphor in chloroform, to which trichloracetic acid had been added, developed an intolerable and pungent odour. This observation showed that the peculiar inertness of chloroform was due to its oxidation to carbonyl chloride or phosgene, and to the consequent elimination of traces of nitrogenous bases, in the form of inert carbamides. The same series of experiments had already shown that some of these bases have an amazing catalytic activity. Thus an acceleration of mutarotation was detected as a result of adding piperidine to benzene in the proportion of 1 part of the base in 10 million parts of the solvent. This acceleration was also one of the earliest examples of a phenomenon which has since become very familiar, namely, a catalysis by bases, which could not be attributed to the presence of hydroxyl ions, and was therefore outside the scope of the conventional theories of catalysis by acids and bases, as developed and used by Ostwald and his colleagues.

An immediate sequel to this discovery was the arrest in silica vessels of the mutarotation of solutions of nitrocamphor in benzene and in ether, to which traces of an anticatalyst had been added. Subsequent experiments showed that mutarotation could also be arrested in solutions of tetramethylglucose in chloroform, benzene, ethyl acetate and pyridine; and Owen developed to a fine art the process of arresting, almost at will and with very few failures, the mutarotation of solutions of tetra-acetylglucose in dry ethyl acetate.

The climax of this work was reached when Faulkner found that the mutarotation of tetramethylglucose could be arrested both in cresol and in pyridine, but proceeded too rapidly for convenient observation in mixtures of these two solvents. Since these mixtures gave velocities of mutarotation which were much greater even than in water, it was clear that the essential factor in promoting mutarotation was not an oxygenated solvent, or an ionising solvent (as had been suspected at earlier periods), or even the ionisation

* *Continued from p.* 921.

of the sugar by an acid or basic catalyst (as most other workers had assumed), but that an amphoteric solvent must be provided to serve as a complete catalyst for the process.

### Prototropy

The migration of a hydrogen atom, in compounds such as nitrocamphor and the sugars, was thus shown to depend on the addition and removal of a proton at two opposite poles of the organic molecule. Since no satisfactory name had been adopted for this important group of isomeric changes, I proposed in 1923 to describe them by the term *prototropy*. The migration of a proton was, however, regarded as only a special example of the more general phenomenon of *ionotropy*, in which a radical migrates from one part of a molecule to another either as an anion or as a cation.

The addition and removal of the ion from the two poles of the organic molecule may be either simultaneous or consecutive, but in either case it leaves behind a positive or negative charge. In order that this type of isomeric change may proceed, it is essential that these opposite charges should be neutralised. The electronic theory of valency allows us to recognise that this is done by the rearrangement of bonds which accompanies prototropic change, since a valency electron is thereby transferred *through the interior of the molecule*, to neutralise the charge of the proton, which is transferred *through the amphoteric solvent*.

The migration of a hydrogen atom, to which the most fertile types of mutarotation are due, was thus linked up to an extended definition of acids and bases, which I set out in 1923, at a time when it must have been in the minds of many other workers, and which was described more fully by Brönsted a few months later. Thus, if we define an acid and a base as a proton donor and acceptor respectively,

$$B + HA \rightleftharpoons \overset{+}{B}H + \overset{-}{A}$$

where B is the base and HA the acid, the migration of a proton in a prototropic compound under the combined action of a base B and an acid HA can be expressed by the equation

$$B + HS + HA \rightleftharpoons \overset{+}{B}H + SH + \overset{-}{A},$$

used by Brönsted and Guggenheim, where HS and SH represent the two isomeric forms of the substrate.

The process of isomeric change, as set out above, can be regarded as an electrolysis of the organic molecule between positive and negative poles, provided by the acid and basic components of the amphoteric solvent. This mechanism has therefore been described as an "electrolytic theory of catalysis by acids and bases". Similar conditions, however, prevail in all conjugated systems, and these can now be formulated in general terms, as systems in which opposite charges at the ends of the system can be neutralised by a migration of valency electrons through the system.

### Rotatory Dispersion

At the time when the earlier measurements of mutarotation were made, it was customary to measure the optical rotations of organic compounds only for the yellow sodium line. Work on rotatory dispersion had indeed been suspended almost completely since the death of Biot in 1862, and the discovery of the Bunsen burner in 1866. It was, however, certain that little progress could be made in elucidating the origin of optical rotatory power, or in predicting its magnitude, until the values of the rotatory power were known over a wide spectral range, instead of for a single casually determined point on the curve of rotatory dispersion.

The ignorance then prevailing in reference to this important aspect of the subject is shown by the fact that, when Drude wished to test his equation for optical rotatory dispersion, he was only able to make use of data for quartz, since the rotatory dispersion of no one of the hundreds of optically active compounds prepared and studied by organic chemists was known with sufficient accuracy to be used for this purpose; and his equation for magnetic rotatory dispersion was tested on data for five wave-lengths only, for carbon disulphide and for creosote.

Experiments carried out in order to supply the data required to determine the form of the curves of rotatory dispersion in organic compounds soon led to definite conclusions. Thus in 1913 I was able to show, with T. W. Dickson, that the optical and magnetic rotations of many simple organic compounds for eight wave-lengths in the visible spectrum could be expressed by *one* term of Drude's equation:

$$\alpha = k/(\lambda^2 - \lambda_0^2).$$

In the following year we found that *two* terms of opposite sign:

$$\alpha = k_1/(\lambda^2 - \lambda_1^2) - k_2/(\lambda^2 - \lambda_2^2),$$

could be used in the same way to express the anomalous rotatory dispersion of ethyl tartrate. This result confirmed the conclusion reached at a much earlier period by Biot and by Arndtsen, that anomalous rotatory dispersion has its origin in the superposition of two partial rotations of opposite sign and of unequal dispersion. These partial rotations may be due to very diverse

causes, ranging from the presence of two optically active absorption bands in the same molecule, to the case in which two liquids of opposite rotatory power and unequal dispersions are arranged in series in separate polarimeter tubes. This diversity has resulted in a certain amount of controversy as to the *origin* of the partial rotations which give rise to anomalous rotatory dispersion, but the essential facts represented by Drude's equation are established beyond dispute.

### Simple and Complex Rotatory Dispersion

On the basis of observations such as these, we proposed to describe as *simple* those rotatory dispersions which can be expressed by one term of Drude's equation, and as *complex* those which cannot be so expressed.

This classification is more fundamental than the earlier classification of those rotatory dispersions which increase progressively with decreasing wave-length as *normal* and of those which exhibit an inflexion maximum or reversal of sign as *anomalous*. Thus, no progress can be made in studying the optical rotatory power of organic compounds until the observed *total rotations* have been resolved into their component *partial rotations*. On the other hand, the distinction between normal and anomalous rotatory dispersion in compounds such as ethyl tartrate depends only on the relative magnitude of the two rotation constants, $k_1$ and $k_2$, of a Drude equation with two terms of opposite sign.

In general, simple rotatory dispersions are only observed when the characteristic frequencies of all the partial rotations lie close together in the Schumann region, giving a dispersion ratio $\alpha_{4358}/\alpha_{5461} = 1{\cdot}6$ approximately. Thus, in the sugar series, the partial rotations associated with the nine asymmetric carbon atoms of cane-sugar give rise to a simple dispersion; but this is not always so, since even in a sugar the characteristic frequencies of the radicals may cover a wide range in the Schumann region, and the foot of the absorption bands often extends into the ordinary ultra-violet.

### Rotatory Dispersion in Absorbing Media

Additional partial rotations of lower frequency give rise in the region of transparency to complex or anomalous rotatory dispersions. In the region of absorption they give rise to the remarkable anomalies which have been known since 1896 as the *Cotton effect*. These anomalies are much more dramatic than those observed in the region of transparency in compounds such as ethyl tartrate. Thus the specific rotation of camphor vapour, which is only about 55° in the yellow visible region, rises rapidly to + 2,000° on entering the region of absorption, then passes through a zero value at about 3000 A. and finally falls to a negative maximum of about − 1,800° before emerging from the absorption band.

In the remarkable case of tetra-acetyl-α-arabinose, $H[CHOAc]_4.CHO$, the partial rotations associated with the three asymmetric carbon atoms cancel out. The whole of the rotatory power is therefore due to the partial rotation associated with the carbonyl group. This gives rise to a symmetrical loop, with equal and opposite maxima $[\alpha] = \pm 1{,}200°$ on either side of a zero rotation at 2909 A. The form of this loop cannot be expressed by Natanson's form of Drude's equation, in which the width of the absorption bands was attributed to a 'damping factor'. It can be represented, with a maximum deviation of 200°, by the equation of Kuhn and Braun, who assumed a probability distribution of *frequencies* in the absorption band; but this deviation is reduced to 30° by using the equation of Lowry and Hudson in which the absorption is distributed symmetrically on a scale of *wave-lengths*.

### Induced Dissymmetry

The existence in camphor and its derivatives of a partial rotation having the characteristic frequency of the ketonic absorption band was attributed by Lowry and Walker in 1924 to the *induced asymmetry* (or better *induced dissymmetry*) of the carbonyl group. According to this conception, the symmetrical carbonyl group becomes dissymmetric under the influence of the unsymmetrical field of an optically active molecule, when coupled sufficiently closely to an asymmetric carbon atom. It therefore contributes directly to the optical activity of the molecule, whereas less polarisable groups, such as $>CH_2$ or $>CMe_2$, contribute relatively little to the total rotation, even when they are exposed to a similar dissymmetric field.

This hypothesis has received support from the molecular theory of optical rotatory power, recently developed by de Mallemann and by S. F. Boys. According to their theory, optical rotatory power in a region of transparency depends on a product of four refractivities divided by the square of the wave-length of the light. It has been shown that this theory can only be extended to the region of absorption by postulating an additional centre of dissymmetry within the chromophoric group in optically active aldehydes and ketones. This extension is in harmony with the conception of induced dissymmetry, which thereby receives important confirmation.

# Obituary

## BARON DE GERLACHE

ADRIEN DE GERLACHE DE GOMERY died in his sixty-ninth year on December 4. When a young lieutenant in the Belgian navy, he conceived the idea of organising an expedition of his own to explore the antarctic regions and had his plans complete in 1894 for a voyage of adventurous discovery. Before he succeeded in raising the very modest sum needed to purchase and equip the *Belgica*, he was induced to make scientific research the main object of the expedition, and with this in view he secured the voluntary help of a group of enthusiastic young specialists including Prof. H. Arctowski as geologist and Dr. F. A. Cook, the only member with polar experience, as surgeon. Roald Amundsen was first officer and the crew was half Belgian and half Norwegian. The *Belgica* sailed in August 1897 and spent some time amongst the islands of Tierra del Fuego, not reaching Hughes Gulf on the coast of Palmer Land until January 23, 1898. Here Gerlache discovered the strait which now bears his name cutting off three large islands from the northern extension of Graham Land. He explored and charted the coasts of this strait and large geological and natural history collections were made. The commander and his scientific staff were now at cross-purposes. He aspired to push on, perhaps to the Pole; they were anxious to remain investigating the rocks and glaciers, birds and marine organisms of a region never before touched by science. The ship went on.

Fast ice prevented any approach to the southern part of Graham Land, and the *Belgica* was headed south-west in an endeavour to reach a high latitude. Gerlache entered the pack early in March, too late in the season, and was unable to extricate the ship, which was frozen in. Thus, contrary to his plan, Gerlache was committed to the first wintering in the antarctic regions, for which the ship was ill-prepared and the provisions unsuited. During the year that followed, the *Belgica* drifted in all directions with the pack, sighting no land but making valuable soundings. The health of all on board suffered greatly, and Danco, one of the scientific staff, died of exhaustion. Before this drift, nothing whatever was known of winter conditions in the Antarctic, and the meteorological observations were thus very important. It was largely due to the courage and tenacity of Gerlache that the party emerged with all its collections in good condition. The large number of antarctic expeditions in the early years of the twentieth century eclipsed to some extent the pioneer work of the *Belgica*; but the imposing array of scientific results produced at the cost of the Belgian Government is an abiding monument.

Gerlache continued to interest himself in polar matters. He commanded the *Belgica* in the Duke of Orlean's scientific expedition to the East Greenland Sea in 1905 and he promoted the building of a fine ice-protected ship designed for sporting cruises about Spitsbergen. The ship was built, and though the project failed, Gerlache had the satisfaction of transferring her to Sir Ernest Shackleton in 1914 and superintended her adaptation as the *Endurance* for the ill-fated expedition to the Weddell Sea.

The slow publication of the *Belgica* results, long suspended by the War, left Gerlache with the last volume of the official narrative practically finished but still unpublished at his death. King Albert created him a Baron in recognition of his great achievements, but Gerlache remained one of the most modest of men and generously allowed his scientific staff all the credit for the work of his expedition. H. R. M.

## DR. N. E. BROWN

NICHOLAS EDWARD BROWN, or "N. E. Br", as he was known to botanists all over the world, died on November 25 at his residence in The Avenue, Kew Gardens, after a few months' illness. This indefatigable taxonomic botanist seemed as keenly interested as ever in his subject at eighty-five years of age, and he was still busy with a monograph of *Conophytum* (a segregate from *Mesembryanthemum*), for which he had prepared a number of beautifully drawn and coloured plates with minute dissections. He was a very good botanical artist, and a skilful microscopist, being a member of the Quekett Club.

Brown was a native of Redhill, and was educated at the Reigate Grammar School. On leaving school he was employed for a few years in the latter town as curator of Mr. Wilson Saunders' Museum of Natural History, whence he migrated to the Kew Herbarium in 1873. There he remained until his retirement in 1914. His work at Kew was mainly concerned with the botany of tropical and South Africa, and he was the acknowledged authority on the flora of the latter country. It was largely through his efforts that the "Flora Capensis" was completed. He was an expert on succulent plants and such difficult families as *Asclepiadaceae*, *Ericaceae*, *Euphorbiaceae*, *Iridaceae*, etc. For many years after his retirement, Brown studied the large genus *Mesembryanthemum*, finding in that assemblage a great number of smaller genera.

Brown had been an associate of the Linnean Society since 1879, and in 1921 was awarded the Captain Scott Memorial Medal by the South African Biological Society in recognition of his work on the South African flora. In 1932, the University of the Witwatersrand, Johannesburg, conferred on him the honorary degree of doctor of science. He was a life-long philatelist. J. H.

PROF. MIKHAILO HRUSHEVSKY, a prominent Ukrainian historian, died in Moscow on November 26, aged sixty-eight years. He was for many years president of the Ukrainian Scientific Shevchenko Society and editor of many scientific journals in Lwow and Kiev.

## News and Views

### Presentation to Sir Arthur Evans

ON December 17 Sir Arthur Evans, at a meeting of friends and colleagues held at the Society of Antiquaries, was presented with a portrait bust of himself in marble in recognition of his services to archæology, and in commemoration of the completion, in a fourth and final volume, of his great work on the excavation of the Minoan site of Knossos in Crete. The bust is the work of Mr. David Evans, a former Rome Scholar in sculpture. It represents Sir Arthur in academic robes and wearing the medal of the Society of Antiquaries, of which he was the first recipient. The greatness of Sir Arthur's contribution to the study of prehistoric archæology, more especially in the Mediterranean area, was fully recognised by Lord Rennell, who presided, and Prof. R. M. Dawkins, who recounted the more notable achievements of Sir Arthur's career. Lord Rennell, in making the presentation, referred to his work as the source of much of the recent fervour for archæological research, which is doing so much to reconstruct past history on more solid foundations and to confirm the authenticity of tradition. It is salutary at times to be reminded that in 1900, when Sir Arthur Evans made his first discovery at Knossos, the great bronze age culture of the Mediterranean, which has since been revealed as one of the more salient phases in the progress of man to a higher civilisation, survived only in a haze of tradition.

THE magnitude of the reconstruction which has given reality to that tradition in a wealth of data accumulated by excavations on sites in Crete, of which Knossos is the most important and impressive, was indicated by Prof. Dawkins in his brief correlation of the site at Knossos with those other areas of excavation in Crete which both supplement and help to interpret it. In like sense he also dwelt on the account of Knossos which appears in Sir Arthur's complete study, "The Palace of Knossos". As he pointed out, there will be found in that work not only a full account of the excavation of the site and the facts which have been revealed at each stage of its uncovering, but also a comprehensive and graphic picture of the whole civilisation of the Minoan age as it flourished in other parts of Crete, as well as of its relations with the world outside. On this side of Sir Arthur's work as a prehistorian it is not possible to dwell here in detail, but to many the imaginative insight which has been displayed in linking up the civilisation of Crete with that of other peoples of the Mediterranean and the near East has been a source of constant inspiration. It was, perhaps, as well that Sir Arthur Evans, in returning thanks, should have reminded those who were present that it was this aspect of his studies which had first attracted him from the Celtic art of Britain to the Ægean.

### Memorial to the late Prof. T. E. Peet

A PROPOSAL to commemorate the services of the late Prof. T. Eric Peet to Egyptology and prehistoric archæology is put forward in a letter which appears in the *Times* of December 18 over the signatures of Lord Derby, Sir Robert Mond, Prof. R. M. Dawkins, Prof. Alan H. Gardiner and others interested in the studies with which the name of Prof. Peet is associated. His premature death in February last at fifty-one years of age was a grave loss to archæology, and came at a time when he seemed at the point of reaping a well-deserved reward for many years of strenuous work. It is suggested that the memorial should take the form of a Thomas Eric Peet travelling fellowship, open to the graduates of any British university who are studying either the Ancient Egyptian language and Egyptology, or the prehistoric archæology of the Mediterranean and the Near East. The fellowship will be attached to the Institute of Archæology in the University of Liverpool, the university with which Prof. Peet was connected all his life and in which he held the Brunner chair in Egyptology for fourteen years. For this purpose an appeal is made for a minimum capital sum of £1,000, the income from which would admit of an award in every fourth year. Should any further sum be raised, it would be utilised in a more frequent award or in grants in aid to approved students. Not only do Prof. Peet's services to archæological studies, which enhanced the prestige of British scholarship, deserve some form of lasting recognition, but the manner in which it is proposed to commemorate them should secure the support of all who are interested in promoting the study of the early history of civilisation.

### Jubilee of Prof. W. R. Williams

ON December 20, the Lenin Academy of Agricultural Science is celebrating the jubilee of the scientific work of Prof. W. R. Williams, of the Timiriaseff Agricultural Academy, Moscow. Prof. Williams has obtained an international reputation by his original views on soil science, and on the part played in the world's history by mankind's maltreatment of the soil. He has attributed the decay of former civilisations to the spread of arable farming which has always accompanied expanding populations, as he believes that only by a system of farming in which the land is frequently returned to grass can the soil's 'crumb structure' be preserved and its fertility maintained. In a paper presented to the second International Soil Congress, he indicated the sociological significance of his ideas in planning the agricultural reconstruction of Russia, and reiterated the need for a balanced system of mixed farming, in which grassland and animal husbandry would play a leading part. Throughout his life he has been an ardent protagonist of the school that believes that the goal of agricultural science is to preserve the fertility of the earth rather than to stimulate it for immediate profit and leave a legacy of exhausted soils to posterity. His strongly expressed views have provoked frequent criticism; but they have succeeded in

focusing attention on what may shortly become one of the most pressing problems confronting agricultural science.

### Augustus George Vernon-Harcourt, 1834–1919

ON Christmas Eve occurs the centenary of the birth of Augustus George Vernon-Harcourt, president of the Chemical Society in 1895–97, professor of chemistry in Christ Church College, Oxford, and one of the Metropolitan Gas Referees. The son of Admiral F. E. Vernon-Harcourt and grandson of Edward Harcourt, Archbishop of York, he was a nephew of William Vernon Harcourt (1789–1871), one of the founders of the British Association and brother of Leveson Francis Vernon-Harcourt (1839–1907), who from 1882 until 1905 was professor of civil engineering at University College, London. A. G. Vernon-Harcourt was educated at Cheam and Harrow and entered Balliol College with a scholarship in natural science, and after studying under Sir Benjamin Collins Brodie (1817–80) became his assistant. In 1859 he was made Lee's reader in chemistry and began contributing papers to the *Chemical News* and the Chemical Society. His earliest researches related to oxidation, and from these he passed to others on the rate of chemical change which—in conjunction with those of Berthelot in France and those of Guldberg in Norway—were to establish on a quantitative basis Berthollet's law of mass action. In much of his work he collaborated with William Esson (1838–1916), the Savilian professor of geometry. In the engineering world he was known for his investigations on coal and coal-gas. When he became a Metropolitan Gas Referee, the old sperm candle of the law of 1860 was the legal standard of illumination, but this was eventually replaced by the 10-candle pentane lamp of Vernon-Harcourt. An interesting episode in his later years was the banquet given in 1910 by the Chemical Society to five of its oldest members who had served as president. The five were Sir Henry Roscoe, Dr. Hugo Müller, Sir William Crookes, Prof. William Odling and Prof. Vernon-Harcourt. Of the five, Vernon-Harcourt, who died on April 23, 1919, was the last survivor but one, Odling outliving him a few years.

### The New Star in Hercules

EARLY on the morning of December 13, Mr. J. P. M. Prentice, who is a regular meteor observer at Stowmarket, noticed a bright star in an unusual position and telegraphed to the Royal Observatory at Greenwich. The message was received at $5^h$, and Mr. Martin promptly secured a spectrum of the nova with the Yapp reflector. The Nova had an apparent magnitude of about 3, and exhibited a typical Nova spectrum with emission lines of hydrogen and helium. By a fortunate chance, a break in the clouds occurred over Greenwich at $12^h\ 40^m$, which enabled Mr. Acton to observe the star's position with the transit circle. Its apparent position at transit at Greenwich on 1934 Dec. 13 was R.A. $18^h\ 5^m\ 38{\cdot}3^s$, Dec. $+45°\ 50'\ 52{\cdot}9''$. The star is very close to the present position of the sun in Right Ascension, but its northerly declination makes it an accessible object at twilight. It is plainly visible to the naked eye, situated about 10° north-west of Vega. A photographic plate was exposed on the astrographic telescope at Greenwich on the evening of December 13, which enabled the nova to be identified with a fifteenth magnitude star on the Franklin Adams plates. It has accordingly risen about twelve magnitudes. Further spectra have been secured at Greenwich and at the Solar Physics Observatory, Cambridge. From an examination of the spectrum, the Astronomer Royal, who spoke briefly on the subject at the meeting of the Royal Astronomical Society on December 14, concluded that the star had just passed its maximum brilliancy when discovered. Assuming the absolute magnitude at maximum to be −6, the Nova is about 2,000 light years away. Subsequent developments in apparent magnitude and spectrum are being watched with interest at a number of observatories. So far as has been ascertained, there was no independent discovery of the Nova. Its position was, of course, communicated through the usual channels on December 13.

### Earthquakes of December 15

Two destructive earthquakes, one of great strength, were felt in different parts of Asia on December 15. Of the slighter, the time of occurrence is not stated, but it may have been the one recorded at Alipore (Calcutta) at 2.15 a.m. (Indian time) or 8.45 p.m. on December 14 (G.M.T.). From the early reports, it appears that more than twenty persons were killed and about a hundred injured, and that at least 25 villages were destroyed. The shocks were strongest in the neighbourhood of Chapakjur, between Diarbekr and Mush, or about ninety miles south of Erzerum. Both Diarbekr and Mush are close to centres of earthquakes of semi-destructive intensity. The second and stronger earthquake was widely recorded. According to the report issued from the Kew Observatory, the first movements were recorded there at 2 h. 8 m. 31 s. (G.M.T.), the epicentre being at a distance of about 4,500 miles. In the largest oscillations that arrived at 2 h. 34 m., the earth movements at Kew exceeded 0·01 in. These are the largest recorded since July 18, due to an earthquake in the Pacific, but they are less than half those from the Bihar earthquake of last January 15. The seismogram at Bombay shows that the epicentre was about 1,300 miles from that city, from which it would seem that the earthquake occurred in Tibet a few seconds before 1 h. 58 m. (G.M.T.). From such a source we are unlikely to receive direct evidence. In the *International Seismological Summary*, however, we find recorded many earthquakes with their centres in that country, an origin that agrees rather closely with the distances given above, being that of the strong earthquake of October 8, 1924.

### Racial Problems in Africa: a Suggestion

MUCH interest has been aroused by a suggestion for dealing with the native problem in East and South Africa, which has been put forward by Col. Carbutt, Chief Native Commissioner for Southern Rhodesia. Writing in the annual publication appearing under

the auspices of the Native Affairs Department, and pointing to the problems which arise from the development side by side of the white and black populations, it seems that he advocates the formation of a dominion in which the interests of the black population would be paramount. Such a dominion, which would permit of the civil and political development to the full of the black population, might, it is suggested, comprise the present territories of Uganda, Tanganyika, Nyasaland and Northern Rhodesia, where white settlement and development have not reached a stage, such as that, for example, in Kenya and Southern Rhodesia, which would prove an insuperable obstacle to this policy. Inevitably, some sacrifice would be involved, but in other areas, in compensation, the interests of the white population would be recognised as paramount. Col. Carbutt stresses the argument, of which indeed the force must be patent to everyone, that a solution of the native problem is vital for the future of the commonwealth of British peoples, and at the same time maintains that such a solution as he suggests would be acceptable to, and indeed welcomed by, the natives themselves. It would appear already to have been received with some measure of approval in Africa, if mainly as representing an advance toward the idea of a federation of the two Rhodesias and Nyasaland, or even of a united East and South Africa.

THE proposal that a dominion should be formed north of the Zambezi constituting what would be, virtually, a vast self-governing reserve for native tribes is an adaptation to conditions in East and South Africa of a proposal put forward some years ago by the late Prof. J. W. Gregory. Prof. Gregory, who was convinced that, on the whole, intimate contact between white and coloured races was harmful to both, thought that the solution of the world's racial problem lay in some such territorial segregation of the white and the coloured races according to their respective adaptation to climatic and other conditions. The black races were to be confined mainly to the tropical belt. The proposal now put forward by Col. Carbutt has the merit that while it might follow as a logical development of the policies of segregation and 'indirect rule', it would afford opportunities for cultural, political and economic development of the native along the lines of his own institutions and without too abrupt a break with tradition, such as will be, it is becoming increasingly obvious, if not impossible, at any rate extremely difficult to secure in present conditions. Clearly the political status of such a dominion would have to be such as to entail a lengthy period of tutelage, pending the attainment by the native of an adequate measure of competence in the conduct of affairs, and to ensure avoidance of difficulties such as have arisen in Liberia.

### Science and Armaments

IN an address before the Bristol Section of the Institute of Chemistry on December 10, Dr. Herbert Levinstein asserted that the destructive power of science in war is absurdly overrated, and that the application of chemical science to war has not made war more dangerous either to soldiers or to civilians. He argued further that scientific warfare is more humane and, because its continual inventiveness introduces an element of surprise, is more likely to bring a war to an early conclusion. The great wastage of life in the War of 1914–18 was due to lack of invention, to reliance on mere numbers of men or projectiles and on obsolete tactics. Dr. Levinstein stressed further the close connexion between chemical industry and chemical warfare, asserting that the prohibition of chemical warfare in the Treaty of Versailles was not due to the horrors of such warfare but to disparity in strength between German chemical industry and that of other countries. He regards as unworkable the suggestion that chemists should agree not to produce any substance used for warlike purposes, because differences between warlike and non-warlike substances are too subtle to be effective.

DR. LEVINSTEIN'S address was doubtless provocative by design but to what purpose is obscure. A discussion on the relative humanity of various methods of warfare is as futile and beside the mark as it is unscientific. Moreover, chemical industry at the present time is scarcely so undeveloped in Great Britain as to merit the rather dubious support which its relation to chemical warfare may lend it. A satisfactory and scientific approach to armament, as to disarmament, is that indicated by Major Lefebure in his book "Scientific Disarmament". The piecemeal discussion of this difficult question is always dangerous and Dr. Levinstein's treatment goes far to nullify the value of his warning that the possibility of chemical warfare cannot be excluded merely by treaty provisions. The moral aspects of the participation of the scientific worker in preparation for warfare were rather too lightly dismissed by Dr. Levinstein, whose remarks here were all the more disappointing because of the need for clear thinking and close discussion by scientific men of this important matter. The creation of a definite professional opinion and code may be a slow process, but it should not be dismissed as impossible. On the other hand, there are definite spheres in which the chemist and other scientific workers can render important services in national defence to which no suggestion of extending the area of conflict can be attached. One such proposal is contained in a long article in the *Retail Chemist* for December in which an organisation of all the chemists of the country to deal with the effects of poison gas attack on the civilian population is advocated. The First Aid posts for gas casualties suggested by Major-Gen. P. S. Wilkinson, of the Order of St. John of Jerusalem, is another such practical proposal in which the knowledge and experience of the chemist might be of direct service to the community.

### Artificial Nuclear Transmutations

LORD RUTHERFORD, in his Ludwig Mond lecture at the University of Manchester on December 10, described how recent work in the study of artificial nuclear transmutations is giving rise to a new

chemistry, concerned not with the outer layers of the atom but with the nucleus itself. The transmutations of one element into another involves adding or subtracting a particle, charged or uncharged, to or from the nucleus, and this may be effected in many cases by bombardment with foreign particles. A few of these particles may enter the nucleus, and this may sometimes lead to the emission of a particle from the nucleus itself. The first of such transmutations was accomplished in 1919, when nitrogen was disintegrated by α-particle bombardment with the liberation of fast protons. More recently, a new type of disintegration has been discovered in which a neutron is emitted. In these cases the residual nucleus in the transformations is stable. In the cases investigated by M. and Mme. Curie-Joliot, an artificial radioactive element is formed by bombarding a light element with α-particles. Fermi and his collaborators have found that a very large number of elements can be disintegrated by neutron bombardment, giving artificial radioactive elements. The neutron, on account of its lack of charge, can penetrate the heavy nuclei when α-particles would be turned back. Finally, Lord Rutherford directed attention to the accomplished production of nuclear disintegration, using bombarding particles artificially accelerated by high voltages instead of the particles emitted from natural radio-elements.

### Science and Road Traffic

In his lecture before the British Science Guild on December 19, Col. Mervyn O'Gorman discussed the application of science to the problems of road traffic. Road traffic, he said, is not replaceable by other distributive agencies, and its prosperity is indeed advantageous to them. The magnitude of motor transport as an industry is such that it has more employees, involves more capital wealth, and pays larger taxation to the State than almost any other industry in England. Improvement which is being, and must be, sought in safety of distribution by road involves getting the largest amount of road distribution achieved per single accident. The business of evolving the necessary instruments, the analytical methods, the interpretation of data, and similar work on the accident ratio is the proper function of science, especially physics, mechanics, mathematics, chemistry, geology, metallurgy, statistics, physiology, psychology, etc. A committee should be formed to advise and undertake research, and it should not contain road interests (financial or professional) and it should receive all the specific 'road and traffic' information that it needs from the Ministries of Transport and of Health, the Home Office and from witnesses. Following the precedent of the successful Aeronautical Research Committee at its foundation in 1908, it should report direct to the First Lord of the Treasury. Its members should be paid, and should all be scientific men, preferably nominated by the Royal Society in conjunction with the Department of Scientific and Industrial Research. The committee having been formed, it should be free to formulate and verify its own theories in the study of safe traffic flow, economic flow, pedestrian flow, etc., these being the frameworks of various long-range researches.

### Maternal Mortality

Sir Hilton Young, the Minister of Health, received on December 11 a deputation from the Maternal Mortality Committee. Mrs. H. J. Tennant, introducing the deputation, said that it represented more than 3,000,000 women and was the outcome of a meeting on the subject of maternal mortality held in November. Mrs. Barton said that malnutrition, though not a primary cause, is a contributing factor to maternal mortality, and she fears that the block grant system of Exchequer grants is less effective in stimulating local authorities than the former percentage grants. Lady Barrett dealt with the question of ante-natal care, and the necessity of improving the training of doctors and midwives. Miss Gregory considers that midwives ought to have a two- or three-year course in a first-class hospital. Other speakers stressed the importance of maternity and child welfare services. The Minister, in reply, said that the problem of maternal mortality is giving him grave concern. The maternity and child welfare services of local authorities are being steadily developed, and he considers that no financial check has been placed upon them by the alteration in the grant system. There is no evidence that there is any close relation between malnutrition and a high maternal mortality rate. Nevertheless, the conditions in depressed areas are such as to give rise to anxiety, and the position is receiving the close attention of the administration. He outlined measures that are being taken to improve maternity and child welfare services throughout Great Britain, and alluded to special inquiries and investigations that are being made in districts where the maternal mortality rate is abnormally high.

### Further Tests of the Medium Rudi Schneider

In the *Proceedings* of the Society for Psychical Research for October is published a further report on the alleged psychic phenomena occurring in the presence of the medium Rudi Schneider. Under the joint authorship of Mr. T. Besterman and Mr. O. Gatty, the paper describes an attempt to look for confirmation of the infra-red phenomena previously reported, and generally to conduct tests by instrumental means. As an example of the kind of methods to be used in experimental work with the so-called physical phenomena, the report seems to be a step in advance, and the results suggest that through such instrumental means a better idea of the nature of the phenomena may be obtained. Generally speaking, the present results were negative. The interruption of the infra-red rays as previously reported by Dr. Osty in Paris and by others in Great Britain received no confirmation, in spite of a series of careful observations; and through the help of of Dr. C. G. Douglas it was ascertained that the medium's breathing, which was considered of sufficient interest to reproduce in a recent series of talks

broadcast by the B.B.C., had nothing supernormal about it, being merely somewhat shallow and quite normal considering the muscular movements made by the medium during the trance. Thus the report as a whole contains no good evidence that Rudi Schneider possesses supernormal powers; and further controversy concerning the case can therefore be postponed until positive evidence is adduced based upon the kind of instrumental methods outlined in the present report.

### National Institute of Industrial Psychology

THE annual report of the National Institute of Industrial Psychology appears in the *Human Factor*, vol. 8, No. 12. The Institute is approaching a critical period in its career, when lack of funds may seriously curtail its research work. The report stresses this fact, and describes the work accomplished along various lines, touching on investigations in factories, warehouses, offices and shops, investigations of the processes of distribution, vocational guidance, research and educational work. A vocational guidance scheme has been launched in Bristol; and large-scale experiments in Fife, and in Borstal institutions, have been completed this year. Researches into the possibility of simplifying and modifying tests of manual skill, and of devising tests for mathematical and linguistic ability, and the part played by rhythm in manual work are being continued. A study of the use of practical performance tests of intelligence and, on the vocational selection side, the analysis of three occupations, namely secretarial work, nursing and secondary school teaching, have been completed.

### Liverpool Geological Society

THE seventy-fifth anniversary of the foundation of the Liverpool Geological Society was marked by a scientific conversazione, under the presidency of Dr. R. G. Wills, held in the Department of Geology, of the University of Liverpool, on December 11. The assembly commenced with the reading of the minutes of the first ordinary meeting of the Society in 1859, after which the Society's Medal was presented to Mr. Emil Montag, Swiss consul in Liverpool, for services rendered to the Society during his twenty-four years' active membership, his editorship, his contributions to British and Swiss geology and his work in providing facilities for study in Switzerland. Prof. H. H. Read, Herdman professor of geology in the University of Liverpool, vice-president of the Society, then delivered a short lecture on earthquakes, followed by a demonstration of the University seismograph. Dr. E. Neaverson lectured on palæontological exhibits, and there was a demonstration of rock-cutting and of new maps. Amongst the exhibits on view at the conversazione was an interesting collection of fossils, new instruments and minerals, the latter including specimens of two new British minerals recently found in Scotland; chondrodite, found in association with metamorphic limestone, and stichite, found in association with ultra-basic rocks.

THE Liverpool Geological Society, which publishes an annual *Proceedings*, has made many valuable contributions to geological history, and among its most distinguished members in the past were George H. Morton, one of its founders, and author of the "Geology of the Country Around Liverpool" (1863). After the Geological Survey had examined the area, a second edition of Morton's work was issued in 1891. The Rev. H. H. Higgins made valuable discoveries of fossil ferns in the Ravenshead railway cutting near Rainhill in 1870, and H. C. Beasley described the well-known labyrinthodont footprints from Storeton quarries, Cheshire, which G. H. Morton later named *Cheirotherium stortonense*. Despite what may be called a geological and palæontological poverty amongst the rocks of its sandstone area, the Liverpool Geological Society has kept research well to the fore in its history, and its *Proceedings* contain many valuable contributions to geological science.

### Apparatus for Photographic Reproduction

THE reproduction of documents, drawings, etc., by photography is, of course, widely practised. It is possible by direct photographic printing to do such work without a camera. With sheets of translucent material of which only one side is used for the design or writing, such a method is capable of furnishing a paper negative which may be used for printing positive copies. The same method may be used for making readable copies which are negatives only in respect of black and white. If, however, the sheets of the original have matter on both sides, this simple method of printing is not possible, and it is necessary to use the method of 'reflex' photographic printing to make a negative, from which positive copies are made by printing through. Reflex printing consists in placing a sheet of the sensitive paper in contact with the matter to be copied, and exposing through the sensitive paper. Differential reflection from the design and its background is sufficient to give a printable image. These methods have long been known and used for the reproduction of copies of the same size as the originals. A very convenient portable apparatus comprising lamps, printing frame and automatic exposure timing device, which we have examined, has now been placed on the market by Messrs. Bornett and Co., Ltd., 7–8 Idol Lane, E.C.3. This apparatus is known as the "Rectophot Rapid Reproducer" and is made in two sizes, the smaller of which will deal with papers 13½ in. × 10 in.; the larger with 22 in. × 15 in.

### Synthetic Compound with Vitamin $B_2$ Activity

As is well known, lactoflavin induces growth in rats fed on a vitamin $B_2$ free diet. In a lecture at the Kaiser Wilhelm Institute for Medical Research in Heidelberg, Richard Kuhn, who with P. György discovered the biological activity of lactoflavin, reported that he had synthesised a compound with the same properties as lactoflavin. The synthetic substance was prepared by interaction of a suitable derivative of 1-nitro-3, 4-xylol with *l*-arabinamin, with subsequent reduction of the product formed and condensation with alloxan. 0·015 mgm. of this substance prevented hypovitaminosis in rats. This dose is of the same order of magnitude as that required for lactoflavin, whereas the corresponding

synthetic substance without the two methyl groups on the benzene ring was completely inactive in this dose. The synthetic substance combines with the protein of the 'yellow ferment' of Warburg, prepared according to the method of Theorell, yielding a catalytically active compound, thus behaving exactly like lactoflavin. The optical rotation in alkaline solution of the two substances is the same. In order to decide definitely whether the two compounds are identical in every respect, Kuhn intends to prepare compounds containing the ribose and xylose radical, instead of arabinose, for comparison.

### Irrigation in India

THE report on "Irrigation in India in 1931–32" (Delhi: Department of Industries and Labour) shows that the total irrigated area in British India in that year fell slightly below thirty million acres, of which more than half was in the Punjab and the Madras Presidency. In the whole area, the figures represent slightly more than 12 per cent of the area sown, rising to 34 per cent in the Punjab and 93 per cent in Sind. Among the largest new irrigation works in progress is the construction of a dam at Mettur on the Cauvery to store flood waters. About half this work was completed by the end of the year. The works in connexion with the new Lloyd barrage at Sukkur in Sind are approaching completion.

### Research in Dairying

THE annual report for 1933 of the National Institute for Research in Dairying, University of Reading, contains a summary of the work done during the year in the various departments, and brief abstracts of papers published from the Institute. Reference is made to the death of the first director, Dr. Stenhouse Williams, in whose memory a new library building has been erected. Attention is also directed to the financial stringency from which the Institute is suffering, and which will necessitate the abandonment of valuable work now being conducted in the Physiology Department and the Nutritional Laboratory unless additional funds are forthcoming within the next few months.

### Exhibition of Architecture

AN exhibition of an interesting character has recently been opened at the new premises of the Royal Institute of British Architects, 66 Portland Place, London, W.1. Here is to be seen a collection of more than 1,200 large photographs of buildings and many models showing recent developments in architecture throughout the world. It has taken two years to bring together this international collection, which is well displayed and is divided into subjects such as public buildings, hospitals, schools, houses, which enables the visitor to compare the designs of leading architects in different countries side by side in a manner which is seldom possible. The exhibition does not deal with planning or construction, but for those interested in these matters there are a few sets of drawings and particulars showing all the stages through which a project must pass before a building can reach completion; the extent of this detailed work will probably be a surprise to the layman. The exhibition is open to the public without charge from 10 to 6 until January 5.

### American Association for the Advancement of Science

THE ninety-fifth meeting of the American Association for the Advancement of Science will be held at Pittsburgh commencing on December 27. On December 31, the retiring president, Dr. Henry Norris Russell, will deliver an address entitled "The Atmospheres of the Planets". Among the general addresses to be delivered are: Prof. E. A. Horton, "*Homo sapiens*, Whence and Whither"; Prof. Arthur B. Lamb, "Crystallogenetic Adsorbents"; Dr. A. Franklin Shull, "Weismann and Hæckel: One Hundred Years"; Prof. H. H. Newman, "Twins reared apart and the Nature-Nurture Problem"; Dr. Mark H. Liddell, "The Auditory Spectrum". Prof. Albert Einstein will deliver the Josiah Willard Gibbs lecture of the American Mathematical Society on December 28. On December 30, there will be a symposium on the relation between science, especially scientific organisations and institutions, and the Press. Speakers will represent the universities, technical and medical schools, the National Association of Science Writers, Science Service, the Associated Press, the Hearst Service and representative newspapers. Further information about the meeting can be obtained from Dr. Henry B. Ward, American Association for the Advancement of Science, Smithsonian Institution Building, Washington, D.C.

### Announcements

SIR ISIDORE SALMON, chairman and managing director of Messrs. J. Lyons and Co., Ltd., has been elected president of the Decimal Association, in succession to Lord Hirst.

THE Karl Sudhoff medal has been awarded by the German Society of the History of Medicine, Natural Sciences and Technique to Prof. T. Győry, professor of the history of medicine in the University of Budapest.

THE annual meeting in 1935 of the British Medical Association will be held at Melbourne on September 11–13, under the presidency of Sir Richard Stawell, consulting physician to the Melbourne Hospital.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in electrical engineering at the North Staffordshire Technical College, Stoke-on-Trent—The Clerk to the Governors, Education Office, Town Hall, Hanley, Stoke-on-Trent (Dec. 31). An assistant in the Technological Department of the Royal Scottish Museum, Edinburgh, 1—The Director (Jan. 12). A principal of the Northern Counties' Training College of Cookery and Domestic Science, Newcastle-upon-Tyne—The Secretary (Jan. 14). An assistant in natural history in the University of Aberdeen—The Secretary (Jan. 20). A Dunville professor of physiology and a J. C. White professor of biochemistry in the Queen's University of Belfast—The Secretary (Feb. 28). A chemist in the Admiralty Chemical Pool—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1.

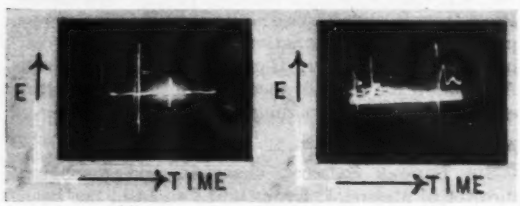
## Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 974.

### The Lightning Flash as Source of an Atmospheric

DURING the last few years we have made, on the roof of King's College, London, a series of observations on the rapid variations of the earth's electric field associated with thundercloud discharges, using a Wilson sphere as the conductor exposed to the earth's field, and a cathode ray oscillograph, with photographic registration, as the recording instrument[1]. In this way we have been able to follow the evolution of an atmospheric wave-form from the discontinuous change of field associated with near flashes to the type of radiation field, with its high-frequency detail, observed at greater distances. These experiments, together with allied investigations carried out at the Slough Radio Research Station of the National Physical Laboratory, were described at the recent meeting of the International Scientific Radio Union in London (September 1934).




(*a*) (*b*)

FIG. 1.

The observations have, however, more than radiotelegraphic interest, for they yield information relating to the nature of a thundercloud discharge. In the older measurements made using the relatively sluggish capillary electrometer, the effect of a net change of field was shown by a single discontinuity on the photographic record. With the string electrometer (as used here by Dr. J. T. Henderson and one of the writers) or cathode ray oscillograph, it is found that, while the most frequent type of discharge is one which takes place in a single 'step', the next most frequent type is one consisting of two or three components. The existence of these component 'steps' obviously indicates that a thundercloud moment is frequently destroyed in a series of partial discharges.

Now if atmospherics originate in lightning flashes, we might expect them to have the same tendency to occur in groups, and this is indeed found to be the case, the order of magnitude of the time intervals between successive components being the same as that observed in the net change observations made on near discharges. Two examples of such grouping are shown in the accompanying records. Fig. 1(*a*) shows a cathode ray oscillographic record of the electric field $E$ during a group of three component disturbances, the wave-forms being unresolved because the time-base stroke is relatively slow (0·1 sec.). Fig. 1(*b*) shows another group of three discharges with a repeating time-base of 0·005 sec. duration. Here the atmospheric wave-forms are delineated and it is seen that the components of the group have very similar wave-forms.

It is obvious that this grouping of the net change 'steps' and atmospheric impulses of similar wave-form is to be correlated with the multiple flashes recorded by Walter and others using a moving camera. We may not, perhaps, be able to classify a thundercloud discharge as a relaxation oscillator, but the intermittent type of discharge appears similar to the familiar periodic sparking of a Wimshurst machine, steadily driven, to which a small Leyden jar is connected.

An interesting feature of the multiple flashes (and the resulting multiple atmospherics) is that a relatively big component discharge is very frequently associated with a relatively long succeeding interval, and vice versa; and in the case of many multiple flashes, the interval between any two successive partial discharges is actually proportional to the magnitude of the first partial discharge. The significance of this would appear to be as follows. We must regard the charge pouring into the head of the channel as reaching a certain critical value before a partial discharge takes place. Whatever be the (variable) amount lost in a component discharge, it appears to be replenished at a constant rate until the same critical value is again reached. An analogous effect would be provided, in the Wimshurst machine experiment cited above, by some agency which, when a spark was in progress, quenched it after a short interval of time which varied from spark to spark.

These experiments, like the allied investigations at Slough, have been carried out as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research.

E. V. APPLETON.
F. W. CHAPMAN.

Wheatstone Laboratory,
King's College,
London.
Nov. 26.

[1] Chapman, NATURE, 131, 620, April 29, 1933.

### The Mass of the Neutron

THE mass of the neutron is considered by Chadwick[1] to be above 1·003 and probably to lie between 1·003 and 1·008. He gives the most probable value as determined by bombardment of boron by $\alpha$-particles as 1·0067. The validity of this value rests on the assumption that $\gamma$-rays are not emitted in the process. Curie and Joliot[2] give a much higher (1·012) and Lawrence and others[3] a much lower (1·0002) value.

On the basis of the values of Fig. 1, and the mass data of Aston and Bainbridge, it seems that a probable lower limit of 1·0052 can be set for the mass of the neutron, by the use of a different

reaction from that of Chadwick. The reaction is:

$$\underset{14\cdot008\pm 0\cdot0028}{N} + n \rightarrow \underset{11\cdot0110\pm 0\cdot0005}{B} + \underset{4\cdot00216\pm 0\cdot0004}{He} \quad (1)$$

Fig. 1 indicates that in this reaction kinetic energy is usually lost, due presumably to the emission of γ-rays or to the production of an artificial radioactivity. This energy contributes to the γ-ray and radioactive energy, which may be denoted by $E_{\gamma+r}$. However, five disintegrations have been obtained: one by Feather, one by Meitner and Philipp, and three in this laboratory, in which kinetic energy is *conserved*. If in this case, $E_{\gamma+r}$ has a positive value, the energy represented by it must be produced from the corresponding amount of mass $m_{\gamma+r}$.

On this basis, the minimum mass of the neutron is 1·0052 and its actual mass ($m_n$) is given by

$$m_n = 1\cdot0052 + m_{\gamma+r}.$$

The greatest uncertainty here is due to the large probable error in Aston's determination of the atomic mass of nitrogen.

The mass of the neutron may also be determined by means of the reaction

$$\underset{9\cdot0155\pm 0\cdot0006}{{}_4Be_9^9} + \underset{4\cdot00216\pm 0\cdot0004}{{}_2He_2^4} \rightarrow \underset{12\cdot0036\pm 0\cdot0012}{{}_6C_6^{12}} + n(+\gamma) \quad (2)$$

from the velocities of the particles and the angles between their tracks. Since the angles are usually unknown, the mass of the neutron can be found only when its maximum velocity is attained.

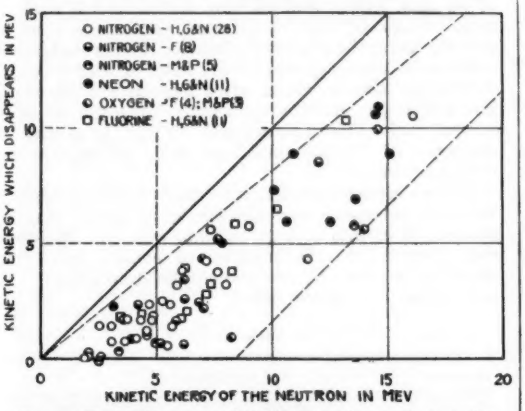



FIG. 1.—The kinetic energy which disappears in a nuclear reaction in which the nucleus specified is disintegrated by capture of a neutron. This energy may be emitted as a γ-ray, or, as has been found of the nitrogen (16) produced from fluorine, the energy takes the form of an induced radioactivity.

The fastest known neutron (energy = 16·1 mev.) produced by a fast α-particle ($E$ = 8·761 mev.) was obtained by Harkins, Gans and Newson from reaction (2). Three other neutrons of energy 15 mev. were obtained by the same reaction. Feather obtained a neutron of 12 mev. energy by the same reaction but by the use of a slower α-particle (5·25 mev.). On account of the fact that the geometry of his apparatus is different from that of the others, the angle θ involved in Feather's work is somewhat doubtful, so his work is not used in obtaining the average value of the mass of the neutron. The calculations are summarised in the accompanying table, in which θ is the angle between the direction of the α-particle and that of the neutron. If the value of θ is greater than that given in the accompanying table, then the true result for the mass of the neutron is less than that given in the table.

Mass of the Neutron as Determined from that of Beryllium by Reaction 2.

| Observer | K.E.-particle in mev. | Number of neutrons | Average K.E.-neutron | θ | Mass of neutron |
|---|---|---|---|---|---|
| H | 8·761 | 1 | 16·1 | 0° | 1·0059 |
| H | 8·761 | 3 | 14·7 | 0° | 1·0073 |
| F | 5·253 | 1 | 12 | 90° | 1·0052 |
| D | 7·683 | | 14·2 | 0° | 1·0068 |
| M | 5·253 | 1 | 13 | 0° | 1·0053 |
| M | 5·253 | 1 | 14 | 0° | 1·0042 |

H = Harkins, Gans and Newson. F = Feather. D = Dunning. M = Meitner and Philipp.

The average of all of the masses, except that of Feather, is $m_{av.}$ = 1·0059, and the average of the two masses obtained by us is 1·0066 as has already been pointed out, but since it is only the maximum kinetic energy of the neutron that should be used, we may put our value of the mass as 1·006.

While the reaction utilised for the determination of the mass of the neutron is different from that used by Chadwick, the basic assumptions involved are the same, namely, that no γ-ray is emitted by the same individual atom which emits the neutron. Also the nucleus which is produced, ${}_6C_6^{12}$, is assumed to be formed in its normal state. If it is in an excited state its mass is greater by $m^*$.

Thus the mass of the neutron is, as determined by

Chadwick : $1\cdot0067 - (m_\gamma + m^*)$
Average of H. and G. : $1\cdot0066 - (m_\gamma + m^*)$.

After a consideration of all of the factors involved, and especially since the term $-(m_\gamma + m^*)$ represents a negative value—unless it is zero, which is by no means certain—we suggest that the value 1·006 be used for the neutron until more accurate positive ray work is done, and also the knowledge of the magnitude of this term becomes more definite. This is only very slightly less than the value proposed by Chadwick. It should be recognised that the term $(m_\gamma + m^*)$, if not zero, would have a different magnitude in the reaction used by him from what it has in that used by us. The accuracy of the lower limit for the mass, 1·0052, is set by the accuracy of the positive ray work on which it is based.

WILLIAM D. HARKINS.
DAVID M. GANS.

University of Chicago.
Oct. 23.

[1] Chadwick, J., *Proc. Roy. Soc.*, A, **136**, 702; 1932.
[2] Curie-Joliot, *C.R.*, **197**, 237; 1933.
[3] Lewis, Livingston, Henderson and Lawrence, *Phys. Rev.*, **45**, 497; 1934.

## The 1933 Everest Climbing Expedition and Oxygen

IN his book "Everest", Mr. Hugh Ruttledge tells us that the best route to the top, planned out by Norton, is "difficult and dangerous . . . imagine a house-roof covered with loose snow of such consistence that it cannot hold the feet and thus prevent a slip". Work is required "of the most arduous and exacting nature". Mr. Smythe was often knee-deep and even thigh-deep on these ledges, and great climber as he is, gained only 50 ft. in an hour. He says "the difficulty of the mountain, the evil effects

of altitude, the possibility of being benighted, the risks of sudden storms, and the danger of exhaustion, are so serious that oxygen should be taken if it can aid the climber. . . . Prior to 1933 there were those to whom the thought of it was abhorrent, I confess to a similar prejudice".

"There is no doubt that long residence at Camp IV and above allowed deterioration to set in."

One climber on returning to the base camp recorded that his "body was a horrible sight . . . all the ribs sticking out and hardly anything on my arms and legs at all". Three climbers suffered from dilated hearts. The rapid recovery of most of the climbers was very noticeable during the return march.

Before the start of the last Everest climbing expedition, I directed attention to Dr. Argyll Campbell's experiments which showed that animals could not be acclimatised to live for long at altitudes above 18,000 ft. Owing to want of oxygen, deterioration set in, and the animals finally showed degeneration of certain organs, such as the heart and liver. They recovered if exposure to the low concentration of oxygen was terminated before deterioration had advanced too far. Dr. Campbell recently has confirmed his previous results; animals can live in a concentration of oxygen equal to 12 per cent of one atmosphere, but not for more than six weeks in one equal to 10 per cent. I ventured to urge the need for the climbers to use oxygen breathing apparatus.

Dr. Raymond Greene says that, according to the modern theory, acclimatisation takes place in three ways: (1) increase in the number of red cells which carry oxygen in the blood; (2) increase in ventilation of the lungs; (3) possibly by active secreting of oxygen into the blood by the lungs. There is no sure evidence of this last. Dr. Greene lays stress on the fact that deep breathing washes carbon dioxide out, and so lowers the normal acidity of the body, but the kidneys correct this by secreting more alkali. There may be a lag in the kidney effecting this correction. To effect this and develop more red cells and the breathing powers, a slow ascent to the base camp is needed.

Dr. Greene leaves out of account a most important means of acclimatisation, one which has been pointed out by Dr. Campbell, namely, hypertrophy of the heart. We know that a hare has a much larger heart than a rabbit, in order to meet the demands made upon it in the effort of rapid flight. The output of the heart and the volume of blood circulating each minute is made much greater by the athlete developing a large, strong heart. This is what the climbers develop by spending ample time in climbing to the base camp and then to the foot of the North Col. It is recorded that "The local Thibetans exhibit greater energy on the Rangbuk glacier than the still comparatively unacclimatised Sherpa porters". We may be sure that these Thibetans must, for their size, like a hare, possess large and powerful hearts. The heart, the blood, the breathing muscles, are all developed by slow acclimatisation, while the nervous system becomes accustomed to enduring the want of oxygen at high altitudes.

During the time spent above 18,000 ft., the limit of possible acclimatisation for prolonged exposure, the vital organs, heart and brain, are maintained at the expense of the other parts of the body, hence the signs of deterioration and wasting.

Experienced Himalayan climbers have the advantage of hearts already developed by previous expeditions. They can climb above the North Col and reach 28,000 ft. and spend even three nights as Mr. Smythe did at 27,400 ft. in a tent carried there by the porters, but even they climb with difficulty, owing to shortage of oxygen. Mr. Smythe reports what apparently were hallucinations. He saw things in the sky and thought he was accompanied when he was alone. He was quite unable to face, above 28,000 ft., a piece of rock climbing which he says he would have tackled under ordinary Alpine conditions. All the time the climbers are deteriorating, and it is a question whether any climber will have a heart stout enough to take him to the top even under the most favourable conditions of weather and snow.

The use of oxygen breathing apparatus is now admitted to be wise for the last and very difficult part of the climb, and for helping the porters to carry material up to the higher camps. It is noteworthy that the breathing of oxygen during the night entirely cured a porter of bad frost-bite, after he had returned from Camp VI to the North Col camp. Two other porters who were much less affected, and therefore were not given oxygen, each lost digits.

LEONARD HILL.

## Experiments on the Fermi Effect

WE have studied the intensity of the Fermi effect obtained under identical geometrical conditions, when screens of different materials are interposed between the beryllium-radon source and the substance in which the Fermi effect is excited.

The absorbing blocks were: a semicylinder of gold of 50 mm. length and 26 mm. radius and a similar semicylinder of lead of 23 mm. radius, both with grooves along the axis for the source. The investigated substances were exposed in the form of nearly semicylindrical sheets which after exposure were bent into a nearly cylindrical form with the Geiger counter in their axis. The counter was 50 mm. long with a diameter of 22 mm. and had walls of aluminium 0·2 mm. thick.

The results are collected in the table below, in which, for each substance and absorbers, we give: (*a*) the number of counts in a given time when no absorber was present, (*b*) the number of counts with the absorber present, (*c*) the percentage diminution (−) or increase (+) of the effect.

Table 1.

| Substance | Absorber | | | | | |
|---|---|---|---|---|---|---|
| | Pb − 19 mm | | | Au − 22·5 mm | | |
| | *a* | *b* | *c* Per cent | *a* | *b* | *c* Per cent |
| Silicon | 4002 | 3370 | −16 | 4290 | 3140 | −27 |
| Aluminium | 4260 | 3412 | −20 | 2881 | 1984 | −31 |
| Silver | 1128 | 1170 | + 4 | 2360 | 2875 | +22 |
| Iodine | | | | 1756 | 2056 | +17 |

The experiments show a marked difference in behaviour of light and heavy substances. In the last case the effect is increased when the absorber is interposed, which shows that the exciting rays undergo some transformation in the absorbing matter. We put forward the following hypothesis. The capture of a neutron by a heavy nucleus without emission of a heavy particle can take place only when the energy of the neutron does not exceed a

certain value. If the energy of the neutron is too high the neutron loses in a nuclear encounter a part of its energy, which is emitted in the form of a γ radiation.

From this point of view the increase of the Fermi effect would be due to the production of slow neutrons in a number more than compensating for the loss of primary slow neutrons due to absorption. That the slow neutrons are active in producing the Fermi effect in heavy elements is made plausible by the experiments of Meitner[1], who used the probably slow neutrons excited in beryllium by the γ-rays of radium.

The block of gold weighing 963 grams was kindly prepared for us by the Polish State Mint and the gold was lent by the Bank of Poland.

Experiments are being continued.

M. DANYSZ.
Mirosław Kernbaum J. ROTBLAT.
Radiological Laboratory, L. WERTENSTEIN.
Society of Sciences, M. ŻYW.
Warsaw, Poland.
Dec. 1.

[1] *Naturwissenschaften*, **22**, 759, Nov. 9, 1934.

## Use of Phosphomolybdic Acid in Chemical Analysis

DURING some recent investigations into the structure of the salts of the 12-heteropoly acids, and, in particular, those of 12-phosphomolybdic acid, it was found that the salts of certain monovalent elements were sparingly soluble. This led us to test whether this fact could be made use of in chemical analysis.

It was found that, using phosphomolybdic acid, a solution containing 1 part of cæsium in approximately 500,000 of water could be detected—a far more sensitive test than that of chloro-platinic acid. With potassium, using a concentrated solution of phosphomolybdic acid, a definite precipitate was formed in an acid solution containing 1 part of potassium in 10,000 of water. With such dilute solutions it should be noted that the precipitate takes a few minutes to form. This test is distinctly more sensitive than that of the cobaltinitrite.

Phosphomolybdic acid should be very useful in analytical chemistry, especially in view of the fact that sodium phosphomolybdate and the salts of the di- and trivalent elements are all soluble. The only other insoluble salts of the acid are the ammonium, rubidium, silver, thallous and mercurous salts.

Further tests are now being carried out by one of us (J. W. I.) with a view to the quantitative estimation of potassium with phosphomolybdic acid. The precipitate obtained consists of potassium phosphomolybdate, $K_3PMo_{12}O_{40}.nH_2O$. The water content has not yet been definitely ascertained, but we have reason to believe that it is not greater than $2H_2O$ and probably zero. The structure is closely related to that of $H_3PW_{12}O_{40}.5H_2O$ recently determined by Keggin[1].

The precipitate is very stable, and X-ray powder photographs show that its constitution is unchanged after heating for several hours at 120° C., whereas potassium cobaltinitrite decomposes on heating.

J. W. ILLINGWORTH.
J. A. SANTOS.
Physical Laboratories,
The University,
Manchester.
Nov. 2.

[1] *Proc. Roy. Soc.*, A, **144**, 75; 1934.

## Oxygen Preparation from Sodium Peroxide

THE account in NATURE of November 17, p. 778, by Dr. Newton Friend and Mr. S. Marks of an explosion which occurred during the preparation of oxygen from sodium peroxide and water interested us particularly, since in 1924 we had a similar experience. The oxygen was being prepared by dropping water on to solid sodium peroxide in a flask, without heating, and was being led through drying tubes to an ozoniser. The water contained a little cobalt chloride to catalyse the decomposition of the peroxide.

The reaction proceeded quietly for some time, producing a steady stream of oxygen; then suddenly, without any apparent change in the conditions, an extremely violent explosion occurred in the flask, with results similar to those described by Messrs. Newton Friend and Marks. The conditions differed from theirs in that the explosion occurred spontaneously without the introduction of a glowing splint: the ozoniser was undamaged, and it is therefore not very likely that the explosion was initiated by the discharge. We attributed the explosion to the presence of free sodium in the peroxide, and have since avoided this method of preparation as dangerous.

G. H. CHEESMAN.
D. R. DUNCAN.
9, Compton Road,
London, S.W.19.
Nov. 22.

## Chemical Linkage

IN the Research Items in NATURE of October 20, certain arguments are advanced in opposition to the views which we expressed in a recent paper published in the *Journal of the Chemical Society*, and without going into detail we wish to take the opportunity of pointing out that: (1) We cannot call to mind any evidence, chemical or physical, for the alleged non-equivalence of the oxygen atoms of the nitro group; the introduction of the 'resonance' linkage is a hypothesis which, in order to maintain a difference of linkage, renders its experimental detection impossible. (2) The existence of two electrons with *parallel* spin in the ground level of the oxygen molecule is definitely established by spectroscopic evidence. (3) X-ray spectra reveal the geometrical arrangements of atoms or ions in the crystal lattice and it is true that it is possible to draw definite conclusions with regard to the physical forces present in simple cases. This is, however, by no means possible in complex cases. Thus $KIO_3$, $CaSnO_3$ and the double salt KF, $MgF_2$ all possess exactly the same arrangement in the crystal lattice. Similarly, the complex salt $[Co(NH_3)_6]Cl_3$, which possesses a characteristic absorption spectrum, has the same lattice as $[Ni(NH_3)_6]Cl_2$, which fails to give a Raman line for a nickel-$NH_3$ linkage, and as $(NH_4)_2SiF_6$, which sometimes crystallises with one or more additional molecules of ammonium fluoride.

R. F. HUNTER.
R. SAMUEL.
Department of Chemistry,
Muslim University,
Aligarh.

I AM still not convinced that the equivalence of the two oxygens in the nitro group is "established" by the zero dipole moment of *p*-dinitrobenzene, nor does the existence of two electrons with parallel spin

in the ground level of the oxygen molecule prove that the molecule is unsymmetrical. It is also true that the "generally accepted deductions" from crystallographic evidence are in favour of the existence of the complex cations $[Co.6NH_3]^{+++}$ and $[Ni.6NH_3]^{++}$ as well as of the complex anion $[SiF_6]^{--}$. It is perhaps desirable to add that, since the note was written, my doubt whether the theoretical views of the authors of the paper would 'hold water' when subjected to a critical examination has been confirmed by consultation with theoretical physicists, who concur in the view that the chemical deductions are based upon an inexact interpretation of current physical theories.

THE WRITER OF THE NOTE.

## Power in Social Psychology

I DO not know how far the columns of NATURE are suitable for the discussion of "power" (in the human community). But when I find no less than three of the nine chief reviews in the issue for December 8 dealing with this question, and Dr. Snow and myself being scolded for "false methodology" and the want of a "robust" political faith, it is perhaps permissible to point out that the class-war dogma which underlies this sort of criticism has no scientific standing.

Social psychology, like every other branch of human ecology, is still in the squinting, vaguely exploratory stage of infancy; we have no adequate description of social "power", no analysis of its miscellany of factors and no clear conception of its attainment or the scope of its operation. We have clear definitions of legal "powers", but these definitions are independent of any qualifications by disregard, resistance or inaccurate or insufficient enforcement. This belatedness of social psychology is a misfortune for the world but it is a fact. That "robust" political faith to which the reviewer urges Dr. Snow, is really emotional doctrinaire mysticism born of impatience and trying to compensate for its poverty of assembled knowledge by a tawdry 'dialectic'.

The premeditated achievement of social resultants is a business for clearer heads and a stouter patience. Formal education, adult education, social stimulation, the mechanisms of production and distribution, a complex of diverse forces, all come into that process. Politicians and rulers of men have to 'get results', but as Dr. Snow's recent novel demonstrates admirably, it is a primary crime against science for a man of science to produce 'results' unjustifiably.

So far as I am concerned, I am not a propagandist but an experimentalist in projection. This class-war stuff, this 'dialectic materialism' is essentially unscientific talk, pseudo-scientific talk; it is literary, pretentious, rhetorical. As sincere, patient and steadfast scientific analysis spreads into human biology we shall begin to get the general concepts of human relationship and social process clear and plain—and then we shall not need to worry about "power"; power will flow to the effective centres of direction. Stalin in our recent conversation accused me of believing in the goodness of human nature. I do at any rate believe in man's ultimate sanity. The political and social imaginations of very many people nowadays seem to me to be obsessed by the transitory triumphs of violence in various countries, and a lot of this talk about the need to organise the illegal seizure of power for direct creative (revolutionary) ends by those masses of the population which presumably have the most unsatisfied desires, is due largely to a lack of perspective in the outlook of the intelligentsia and a want of patience and lucidity in their minds. There is a limit to the concentration of power in human society, beyond which it becomes ineffective and undesirable. The limit has been passed in Germany and Russia to-day.

H. G. WELLS.

I CANNOT answer for the implications Mr. Wells has drawn from the other reviewers. For myself, I am amazed that he does not see himself as a propagandist among his other rôles. Others do; and that is good enough for scientific purposes. Talk of the *seizure* of power in present-day England is, of course, just rubbish. That question has not been raised. What was being discussed was, 'From which fulcrum would the lever for change to the Wellsian World State be finally applied?' Mr. Wells seems to see it in the people in key positions, but paradoxically enough he complains that they have not the brains to see. What then? My contention was that it is not simply an intellectual "seeing" that he must seek but an active desire, a liking for his world solution.

Mr. Wells has left out the emotional content in assent to a social solution. His letter repeats it in simply demanding more scientific examination, as if objective science covered the whole of life, and yet he bases his case on two scientifically unverifiable assertions:

(1) He believes in man's ultimate sanity, meaning, I suppose, that he *feels* people in key positions will ultimately accept his solution.

(2) Power will flow to the effective centres of direction, meaning that he *feels* this will be so although he does not see it happening to-day in Russia and Germany.

I do not see why he should expect others to share his sanguine feelings.

H. LEVY.

## Relationship of Soils to Manganese Deficiency of Plants

MANGANESE deficiency disease is confined to soils of *p*H 6·7 or more and occurs especially on heavily limed sandy podsols. Most neutral and alkaline soils, however, evidently contain ample quantities of manganese in a form available to plants. A method of chemical analysis has been found which appears to measure the amount of this available manganese.

(1) The soil is first leached with normal ammonium acetate of *p*H 7·0. This removes the manganese which can take part in the base-exchange reaction at such a high *p*H. The amount of this manganese is very small for all alkaline soils, and is well below one part per million of soil for the very fertile calcareous grey soils of the Wimmera districts (Victoria), on which no symptom of deficiency has ever been seen.

(2) The residual soil is then leached in the cold with the same reagent containing 0·2 per cent quinol in solution. (Each leaching is completed in about seven hours.) This second treatment dissolves only those manganic compounds which can oxidise quinol at *p*H 7 with reasonable speed.

This 'active $MnO_2$' (using a conventional formula to represent manganic oxides) exceeds 100 parts of manganese per million of soil in the healthy soils tested, and is less than 15 parts in soil associated with manganese deficiency. This is the only test

of many tried which shows a clear difference between healthy and 'deficient' soils.

It seems to follow that manganese is absorbed by the root without first passing into the soil solution as the ion $Mn^{++}$; the absorption might be either direct as colloidal $MnO_2$, or by reduction of $MnO_2$ at the root-soil interface—a reduction which becomes steadily more difficult as the *p*H rises, until only very active $MnO_2$ can take part in the reaction.

This same test may be expected to show whether it is dangerous to lime on acid soil; trouble may follow if the total manganese dissolved by ammonium acetate and quinol at *p*H 7 does not exceed about 15 parts per million of soil. This suggestion cannot be tested here at present, since manganese deficiency following overliming has as yet been proved on only one Australian soil, itself abnormal. It is thought also that light may be thrown on the state of manganese in the soil horizons by leaching with buffer solutions (such as ammonium acetate) of varying *p*H values, with or without the addition of reducing agents (such as quinol) capable of bringing about definite *r*H values. The details of the work will appear in the *Proceedings* of the Royal Society of Victoria.

G. W. LEEPER.

School of Agriculture,
University,
Melbourne, N.3.
Oct. 18.

## Publication of *Nomina Nuda*

DR. VAN DER HORST'S communication in NATURE of December 1, p. 852, is of much interest in giving exact information with regard to the conformation of the burrow of an Enteropneust—a subject about which little is known. Without wishing to detract in any way from the value of his note, I find it necessary to criticise one part of it. It is well known to workers in systematic zoology that great inconvenience is caused by the publication of *nomina nuda* or names which are unaccompanied by diagnoses of the new species to which they refer. The binomial designation given to the new species of which a description is to be published later by one of Dr. van der Horst's students is presumably of this character. It may indeed prove to be the case that the form of the burrow is by itself distinctive of the new species; and it might perhaps be argued that since this had been described and figured the name is valid. There are probably few zoologists, however, who would recognise a species of which the type-specimen was a mass of sand and mud containing no part of the animal itself except some of its slime.

The trouble given to taxonomists by introductions of this kind is very real. It is often necessary to waste time and print by explaining why the date of the first mention of a name cannot be accepted as the valid date. Many instances are known in which the *nomen nudum* has not been reprinted, but it remains to encumber the literature. The most troublesome cases, however, are probably those in which controversy is possible on the question whether a name is a *nomen nudum* or not. I feel confident that the great majority of systematists would agree with me in requesting the editor of NATURE to delete all such names from future communications sent for publication in his pages.

SIDNEY F. HARMER.

Melbourn, Cambs.
Dec. 1.

## Design of Theodolite Axes

IN NATURE of September 15 a letter from Prof. A. F. C. Pollard points out that the cylindrical bearings adopted for the vertical axis of the Wild precision theodolite leads to a systematic error of the "order of two to four seconds" in the horizontal angles. We, in Egypt, have not had much experience with theodolites of the Wild design, but we have found that the substitution of cylindrical for the old Y-bearings for the telescope (trunnion) axis of English theodolites has not been found to be an improvement but very much the reverse. Whilst the instrument is new, the errors arising from this fault in design do not obtrude themselves, but as soon as the bearings become worn or one of the standards gets slightly bent, the telescope comes to rest in a different position every time it is raised or lowered in elevation. The error arising from this defect is of an 'accidental' nature and may, in an extreme case, amount to one minute.

Another defect in modern English design adopted by some firms is the tightening arrangement for taking up wear in the levelling screws. The old-fashioned method of making a vertical radial cut along the centre of the trivet arm and placing a binding screw at its outer end was perfectly satisfactory and should never have been given up. The modern designs either do not work at all or they grip the screw at one point only instead of along the whole length of the thread.

In addition to these defects, we have had trouble owing to the poor optical qualities of the modern telescopes. Distant points which are easily sighted with an old-fashioned theodolite are invisible in a modern telescope. This is probably due to the adoption of the internal focusing arrangement. The introduction of an additional lens (or lenses) in the optical system cuts out light and impairs the definition.

Speaking generally, the so-called 'dust-proof' covers are a continual source of trouble. We have never found one which keeps out the dust. Also they make the theodolite much more difficult to keep in good order.

Leaving out of account modern instruments of the Wild type, the old Troughton and Simms six-inch theodolite of thirty years ago was the nearest approach to a perfect instrument for field triangulation that has yet been made. We have not found any modification in the design of this type of instrument which has not been found by experience to be a change for the worse.

F. S. RICHARDS.

Survey of Egypt,
El-Giza.

MR. F. S. RICHARDS'S letter is an interesting corroboration of the points raised in my original communication and it is hoped that theodolite manufacturers will give the criticisms of Rannie and Dennis, as well as those of Richards, the attention they deserve.

Mr. Richards's remarks about levelling screws are important. In the paper by Rannie and Dennis, to which I have given the reference, it is recorded that badly designed levelling screws were a source of error in the readings of the instrument. In their case, changing the positions of the levelling screws and clamping them strained the alidade axis. Mr. Richards complains that in modern designs the screw-spindle of the levelling screw is imperfectly clamped.

These imperfections can be completely and readily

eliminated by correct design. I have described the correct design of the tapped seating for screw-spindles on p. 52 of my monograph on "The Kinematical Design of Couplings in Instrument Mechanisms" (Adam Hilger, Ltd.) and also in the Thomas Hawksley Lecture[1] for 1933. In the latter will also be found a description of the correct design for the seatings of the ends of the levelling screws for a theodolite, which is just as important as the correct design for the seating of the screw-spindle if strains are to be reduced to a minimum.

A. F. C. POLLARD.
Imperial College of Science and Technology,
South Kensington.
Nov. 29.

[1] *Proc. Inst. Mech. Eng.*, **125**, 154 and 177; 1933.

## The New Star in Hercules

THE discovery of this star in the early morning of December 13 by Mr. J. P. M. Prentice at Stowmarket was kindly reported to the Solar Physics Observatory at Cambridge by the Astronomer Royal later in the same morning. Watch has been kept the whole of each night since, the star being circumpolar, and spectra were obtained with the Newall telescope in the early mornings of December 14 and 15. The spectrum is of the usual Nova type, just after maximum brightness, consisting of bright bands of hydrogen and of ionised metals with absorption borders on the side of shorter wave-length. The unusual features on this occasion are the outstanding strength of the displaced absorption lines due to Mg II at 4481 and the fact that the velocity of approach given by the hydrogen and other absorption lines has shown a decrease from about 500 km./sec. to about 250 km./sec. between December 14 and 15. This decrease of the velocity of the first outburst was shown by Nova Geminorum 1912, but it is not a usual feature in Novæ.

F. J. M. STRATTON.
Solar Physics Observatory,
Cambridge.

## Red 'Water-Bloom' in Iceland Seas

COMMENTING on Mr. John Hart's note[1] on blood-red water-bloom caused by a ciliate in South African Seas, I may refer to a description of exactly the same thing caused by apparently the same organism, but in Iceland waters, published in *Meddelelser* from the Danish Kommissionen for Havundersögelser (Ser. Plankton 1, No. 8, p. 27; 1909). Hence this phenomenon seems to be, if of short duration, widely distributed, and has previously been recorded.

OVE PAULSEN.
Plankton Laboratory,
Hellerup, Denmark.
Oct. 10.

[1] NATURE, **134**, 459, Sept. 22, 1934.

## Points from Foregoing Letters

LIGHTNING may take place either in a single discharge or step-wise, according to evidence obtained with the string galvanometer and the cathode ray oscillograph. Study of the atmospherics which originate in lightning flashes has led Prof. E. V. Appleton and Mr. F. W. Chapman to the view that, when intermittent, lightning is similar to the discharge from a Wimshurst machine to which a small Leyden jar condenser is connected, the frequency between successive discharges being often proportional to the magnitude of the first spark. It seems as though the electrical energy used during the first lightning stroke is being replenished at a constant rate, until a critical value is reached.

A knowledge of the mass of the neutron is important in calculating the energy involved in atomic transmutations. Prof. W. D. Harkins and Dr. D. M. Gans obtain as the most probable value for this constant, 1·006 (oxygen = 16).

The radioactivity induced in silver and iodine by bombardment with neutrons (obtained from a beryllium-radon source) is greater if the neutrons are first passed through a thick barrier of gold or lead; the opposite is true of the radioactivity induced in the lighter elements, silicon and aluminium. This result, obtained by a group of Polish investigators, leads them to the view that the capture of a neutron by a heavy nucleus without the emission of any heavy particle (Fermi effect) can take place only when the energy of the neutron does not exceed a certain value.

Phosphomolybdic acid will detect two parts of cæsium in a million of water, and will precipitate one part of potassium in ten thousand parts of water; it is therefore more sensitive than the cobaltinitrite test, according to Mr. J. W. Illingworth and Mr. J. A. Santos.

Chemical combination, according to Prof. R. F. Hunter and Prof. R. Samuel, consists always of the coupling of atoms by means of the entry into the same group in the molecule of two electrons possessing opposite (antiparallel) spin. They disagree with the views that a single electron can act as a bond, and that two electrons coming from one of the atoms only can act as a link, as envisaged by Sidgwick in the case of one of the oxygens in the nitro group ($-NO_2$), and they claim that all evidence points to the two oxygen atoms in the nitro group being linked in identical manner. Their views were criticised in a Research Item, the writer of which now states that he believes their theoretical conceptions to be unsound.

Manganese, in small quantities, is essential to plants. Mr. G. W. Leeper describes a method of determining the available manganese in soils, and suggests a mechanism for its absorption by plants. He finds more than 100 parts of this element per million in 'healthy' soils; less than 15 parts per million leads to manganese deficiency diseases. This condition is likely to occur in alkaline soils (*p*H 6·7), particularly in podsols, and it is inadvisable to render such soils more alkaline by the addition of lime.

Mr. F. S. Richards directs attention to several imperfections in the design of the axes of theodolites used in survey work, and also in the optical qualities of the telescopes. Prof. Pollard expresses the hope that theodolite manufacturers will take note of the various suggestions which are being made.

## Research Items

**Uganda and Zimbabwe.** The existence of ancient earthworks in Northern Buddu, Uganda, known to the natives as *Biggo bya Muzenyi* ("The Stranger's Forts"), was reported so long ago as 1909 in the *Uganda Official Gazette*, and a report on the "ancient trenches", with plans, was made by A. D. Combe, field geologist, in 1922, but is unpublished. Mr. E. J. Wayland now contributes some notes on these earthworks and other adjacent remains to the *Uganda Journal*, **3**, No. 1, accompanied by Mr. Combe's plans, which are published for the first time. The fortifications, as originally described, consisted of an outer rampart and ditch extending for more than 2½ miles, with flanks resting on the Katonga River, and interior works on a low hill in the centre of the position. The ramparts, much weathered, were still 3–6 ft. in height and the ditch 4 ft. deep. In the centre are two artificial mounds 10–12 ft. high. Small outlying forts exist some six and four miles respectively to west and east. The usual Baganda tradition attributes the origin of these works to a stranger who entered Uganda from the north. Fragments of circular pottery dishes about 4 ft. in diameter were found by Mr. Combe. At Ntusi, 7½ miles south-west from Biggo, traces of apparently irrigation works and middens were examined, and pottery was found here which did not resemble anything now made in Uganda. Although a pottery pipe belonging to a native blacksmith's forge was found, there was no trace of metal. Other traces of occupation are pit-dwellings and shafts of unknown purpose. These works have been attributed to immigrants from Abyssinia who passed on to build Zimbabwe; but this is improbable. There is, however, a strong probability that, though less ancient, they are a more primitive form of the Zimbabwe structures, and like them of Bantu cultural origin.

**Algerian Stone Age.** The site of a rock-shelter in the neighbourhood of Oran, Algeria, has been investigated by M. Paul Pallary, in a series of excavations, which began in 1928 in response to a suggestion made by M. Boule in the previous year. A detailed account of the site has now appeared (*Mem.* 12, *Inst. de Paléontologie humaine*). The sides of the ravine in which the shelter was situated have long been known to have been honeycombed with habitations of prehistoric man, and the site of the Abri Alain, as M. Pallary has named it, was visited by him in 1906, when he obtained examples of a microlithic industry. The shelter itself has now disappeared, owing to quarrying operations, but the remains of the deposits lie on the site. Fortunately, one portion of the floor was found to have been left undisturbed. This showed four distinct levels under a sealing of calcareous deposit. Of the four levels the two lower are of a yellow colour, above them is a layer of black earth and above that one of chocolate-brown. The black earth level contains a very large number of crushed shells, whereas in the lower levels shells are rare and intact. The characteristic microlithic industry of the site, however, shows little to differentiate the yellow from the black strata, except possibly a slight difference in refinement of workmanship. M. Pallary considers that the results of the excavation support his view, in which he is opposed to his archæological colleagues, that certain pedunculate implements, usually classed as Mousterian, are late and must be regarded as neolithic. This view, it is held, follows from the fact that such implements are, as a rule, found on the surface of shell-heaps. M. Pallary appends a bird's eye view of the stone age cultural succession in North Africa, in which the primitive hand-axe and Acheulean culture are regarded as comparable to the European industries, while 'Aterian' for a localised Mousterian is rejected, and *inter alia*, the term 'Ibéro-Maurusian' is regarded as preferable to 'Capsian' on the ground of priority and conformity to the practice of scientific nomenclature.

**Nematodes of the Belgian Coast.** "The Free-Living Nemas of the Belgian Coast (2). With General Remarks on the Structure and System of Nemas", by L. A. de Coninck and J. H. Schuurmans Stekhoven, Jr. (*Mém. Mus. R. d'His. Nat. de Belgique*, No. 58, Dec. 1933), is a continuation of the first monograph by the latter author and Adam, in the same publication (No. 49, 1931). Extensive collections were made of mud and sand in the environment of the Canal of Zeebrugge, between Heyst and Zeebrugge, in and around the harbour of Ostend and in the Zwyn. Ten different habitats were investigated, the samples sieved through fine gauze of varied sized mesh and all the nemas counted. Interesting results were obtained, certain forms predominating in certain habitats. It was found that where Chromadoridæ prevailed an *Enteromorpha* species was abundant, the Monhysteridæ liked sandy and shelly districts, whilst the abundant *Bathylaimus assimilis* was found among decaying leaves of *Statice limonium* growing in the sand in a shallow channel filled with brackish water. The discussions on the relationships of the genera and families are very helpful, for the group is an exceeding difficult one. The larvæ and young forms often differ considerably from the adults, and great care must be taken to distinguish them. 2,408 individuals were studied, consisting of 63 species belonging to 39 genera. Several of the species are new to science, and many new to the Belgian fauna.

**The Genus *Mallomonas*.** Dr. W. Conrad, in his work "Revision du Genre *Mallomonas* Perty (1851) incl. *Pseudomallomonas* Chodat (1920)" (*Mém. Mus. R. d'His. Nat. de Belgique*, No. 56. Brussels, 1933), adds much to his former monograph on the same subject, published in 1927 (*Arch. Protist.*, **59**). He now abolishes altogether Chodat's genus *Pseudomallomonas*, the members of which merge naturally into *Mallomonas*, and attaches great importance to the scales which ornament the cell in the different species. Setiform appendages, present in many forms, although distinctive, have in his opinion only a relative value, for they vary in the same species and are easily lost on fixation. *Mallomonas* is an interesting genus with several peculiar features. Besides the curious armature of scales, conical, triangular, quadrilateral, elliptical, discoidal or circular, which are arranged in various ways round the cell and vary little, there may be darts or needles of peculiar shapes, and one or two chromatophores may be present, or these last are sometimes so reduced as to be scarcely perceptible. The shape of the cell is circular, oval or elongated with a long flagellum and sometimes a collar, and the cysts formed inside the cells are very characteristic.

**New Echinoderms from Puerto Rico.** Austin H. Clark, in two papers, "A New Genus of Brittlestars from Puerto Rico" and "A New Starfish from Puerto Rico" (*Smithsonian Misc. Coll.*, 91, Nos. 13 and 14. Johnson Fund. "Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep". Pubs. 3248 and 3249, May 1934), describes some interesting new starfishes. One of these is a curious Ophiuran representing a new genus of the family Hemieuryalidæ. *Quironia johnsoni*, n.gen. et sp., resembles *Sigsbeia* but with certain distinctive features. The family as at present understood includes ten genera, of which six occur in the West Indies. Of these six West Indian genera, four are known only from the Caribbean region, one is found also in other parts of the tropical Atlantic and one is represented also in the Galapagos Islands. In the second paper a new species of *Odinia* is described. This is specially interesting as the family to which it belongs, although well represented on the Atlantic coasts of Africa and of Europe, is known from the Caribbean region only from the single somewhat problematic genus *Hymeno discus*, which was described from a single species represented by two evidently young individuals.

**Resistance to Cutting of Vegetable Tissues.** Henri Prat has recently described an ingenious apparatus for determining the force required to drive a safety razor blade through the tissues of a plant, under conditions which are standardised in application (*Canad. J. Res.*, 11, No. 4). The method is open to criticism in points of detail, but the differences in the behaviour of different regions of the same grass internode are obviously far too great to be masked by any of the experimental errors associated with the method. In these preliminary observations the new method has probably told the author nothing that is not readily deduced from the known developmental history of the grass shoot, but any attempt to introduce new numerical data in the comparison of biological qualities deserves sympathetic consideration.

**Effect of Cane Molasses on Swamp Soil.** Further investigations on the rôle of organic matter in plant nutrition are discussed by T. R. Bhaskaran and others (*Proc. Ind. Acad. Sci.*, 1, No. 4, 155). A solution of molasses, an abundant by-product of the sugar industry consisting of easily fermentable sugars with a small percentage of minerals and nitrogen, was added to soil samples, and the whole submerged by addition of water. The supernatant solution was then analysed at intervals for several weeks. The sugars are mostly decomposed a few days after addition, forming lactic, acetic, propionic and butyric acids, minute quantities of ethyl alcohol, acetaldehyde and fusel oil. The gaseous products consist of abundant carbon dioxide with small amounts of hydrogen, methane and other hydrocarbons, arising presumably from bacterial action. Most of the carbon dioxide produced is lost from the soil system. The acid products of fermentation bring about the solution of increasing quantities of minerals, which, however, are reprecipitated after about a month, when the concentration in the solution resumes its original value. The concentrations of iron and aluminium early assume toxic values, but decline later to the initial level. Dissolved iron is present in the ferrous condition, perhaps in association with organic acids. The solubility of phosphorus is not affected, but considerable amounts of potassium and calcium dissolve and remain in solution for two months. The treatment with molasses causes a temporary increase in the bacterial content of the soil, whilst Actinomyces and fungi show a rapid decline. Protozoa are also adversely affected, whilst the growth of yeasts is inhibited entirely. Some of the most prominent bacterial forms include *B. subtilis*, *B. graveolens*, *Sarcina*, and other forms yet unidentified.

**Geology of the Orkneys.** In a lecture delivered at the Geological Society on November 7, Sir John Flett announced that the geological survey of the Orkneys has now been completed on the six-inch scale, and that definite information has become available on many hitherto obscure or debatable points. The structure of the area is simple, and consists essentially of a broad gentle anticline in the West Mainland and a syncline in the North Isles. Scapa Flow is bounded on three sides by important faults. The basement rocks of granite and schist are exposed near Stromness and present many of the characters of the Strath Halladale granite and the Altnaharra type of Moines. Over a thin basal conglomerate lies a series of grey and blue flagstones probably 10,000 ft. thick with two well-defined fossiliferous horizons with *Pterichthys milleri* and *Coccosteus minor*. The Middle Old Red Eday beds are sandstones, flags and reddish marls, with a fish-bed containing *Tristichopterus alatus*. Basalt flows are present in this and the succeeding Hoy sandstones. Close correlation has been established between the Stromness, Rousay and Eday beds of Orkney and the corresponding Achanarras, Thurso and John o' Groats beds of Caithness. The Upper Old Red sandstones of Hoy, which are unfossiliferous and probably 4,000 ft. thick, are separated from the beds below by a great unconformity marking the erosion of thousands of feet of strata. Numerous dykes of bostonite, camptonite and monchiquite traverse both Middle and Upper Old Red Sandstone, but their age is still undetermined.

**Submarine Terraces around Japan.** In an interesting paper (*Earthq. Res. Inst. Bull.*, 12, 539–565; 1934), H. Yabe and R. Tayama describe the relief of the sea-bed around Japan and Korea. The coasts of both are surrounded by submarine terraces, from four to nine in number. The three upper terraces (of depths 0–30 m.) occur only in certain areas. The next three (of depths 40–60 m., 80–100 m. and 120–140 m.) are well developed in nearly all parts, the sixth attaining in one place a width of 15 km. Below this is a scarp always steep and distinct, that forms the outer margin of the continental shelf around Japan. The seventh terrace ranges in depth from 200 to 230 m., and in width to 20 km. The eighth and ninth terraces (of depths 300–350 m. and 600–800 m.) are limited in distribution. All the terraces are crossed by deep furrows lying along continuations of adjoining river-valleys, and not differing from them essentially, obviously submerged river-valleys. There are also what appear to be fault-valleys, etc., usually parallel to the general trend of the coast-line, especially on the Japan Sea side, while others, as in Sagami and Suruga Bays, trend radially to the coast.

**Pressure Waves from Explosions.** We have received from the Safety in Mines Research Board, Paper No. 88, "The Pressure Wave sent out by an Explosive" (3), by Messrs. W. Payman and D. W. Woodhead.

This is really a continuation of the investigation of the ignition of firedamp by coal-mining explosives, upon which one, at any rate, of the authors has been engaged for some years past. Previous investigations have led to the conclusion that these ignitions might be caused by flame from the explosive, the shock wave of the explosion or the projection of particles in a chemically active or an incandescent state. Although these factors are not really separable in practice, attempts have been made to examine them independently by experiment, and this paper is a preliminary account of the application of *Schlieren* photography to the waves sent out by working charges from blown-out shots of explosive either unstemmed or very slightly stemmed. The photographs show that, in addition to the main shock wave, there are certain conical prominences, of which two types appear to have been observed, namely *open* prominences and *cored* prominences. It would appear that the open ones are due to the projection at high speed of particles producing conical wave systems, whilst there is still some doubt as to the nature of the agent producing the cored prominences, two explanations being forthcoming. It cannot be said that any definite conclusions have yet been reached or that the investigation has up to the present yielded practical results, but, of course, it is scarcely fair to judge by such inconclusive experiments.

**Segregation of Polonium in Bismuth Crystals.** In order to explain the effect of impurities on the magnetic properties of bismuth crystals, Goetz and Focke assumed that the impurities segregated into a superlattice structure in the crystal. A. B. Focke has recently investigated this hypothesis by an ingenious method (*Phys. Rev.*, Oct. 1). A bismuth crystal is made containing polonium as an impurity, and the distribution of ranges among the polonium $\alpha$-particles emitted normally from a crystal face is studied with a Geiger counter. Steps in the distribution curve indicate the presence of planes in the crystal in which the polonium is segregated. With a small concentration of polonium, the atoms of the latter were apparently segregated into small regions in planes spaced at $0{\cdot}54\,\mu$ separations parallel to the (111) planes and at $0{\cdot}90\,\mu$ separations parallel to the $(1\bar{1}1)$ planes. These separations are independent of the rate of growth of the crystal and of heat treatment. The addition of tellurium suppresses the layers parallel to the $(11\bar{1})$ planes and apparently gives a lamellar arrangement of the polonium atoms, with planes parallel to the (111) planes and having a separation of $1{\cdot}1\,\mu$.

**Isotopic Ratio of Oxygen and the Atomic Weight of Hydrogen.** The atomic weight of hydrogen determined by the mass-spectrograph is 1·00778 ($O^{16} = 16{\cdot}0000$), the values given by Aston and Bainbridge being in very close agreement. The value on the chemical standard, $O = 16{\cdot}00$, is obtained by dividing by the conversion factor, $f$, which is equal to the ratio of the physical atomic weight of oxygen to the chemical value. The physical atomic weight of oxygen is calculated from the ratio $O^{18} : O^{16}$, which according to Babcock (1929) is 1 : 1250, whilst Mecke and Childs (1932) give 1 : 630, and Aston (1932) 1 : 536. The value of Mecke and Childs gives 16·0035 for the atomic weight of oxygen ($O^{16} = 16{\cdot}0000$), and for the conversion factor, $f$, 1·00022. This gives 1·00756 for the atomic weight of hydrogen derived from the mass-spectrograph data, on the standard $O = 16{\cdot}00$. This value is considerably lower than the accepted chemical value. According to Moles, the mean of the values for the chemical atomic weight of hydrogen obtained by five different authors is $1{\cdot}00777 \pm 0{\cdot}00002$. In order to investigate this discrepancy, H. Muckenthaler (*Phys. Z.*, 35, 851 ; 1934) has re-determined the ratio $O^{18} : O^{16}$ by the mass-spectrograph, and has obtained a value of $1 : 1058 \pm 69$, the actual figures varying from 830 to 1300. Taking the ratio as 1 : 1000, the physical atomic weight of oxygen is 16·00240, and $f$ is 1·00015. The atomic weight of hydrogen on the chemical standard would then be 1·00778 divided by 1·00015, that is, 1·00763, which is in better agreement with the chemical value. The author also describes experiments which indicate that the lighter isotope of hydrogen, $H_1^1$, diffuses more rapidly through heated palladium than the heavier isotope, $H_1^2$.

**Petroleum Products as Insecticides.** Under the auspices of the Institution of Petroleum Technologists, a useful paper on "The Utilisation of Petroleum Products as Horticultural Spray Materials" was read at a meeting at the Royal Society of Arts on November 13, 1934, by Dr. Hubert Martin of the Long Ashton Research Station, Bristol. Dr. Martin showed that the ovicidal and insecticidal properties of petroleum oil sprays applied to trees in winter are independent of the base of the oil, of its type of emulsification and of its viscosity over a wide range. Petroleum oils for summer insecticides must be highly refined, and their efficiency seems to depend upon a sufficient degree of viscosity, and upon a relative instability of the emulsifier. The relative values of several emulsifiers are described, and their use in combined insecticides is also reviewed. Petroleum oils can be used as 'wetters' or 'spreaders' for other insecticides, and this property was dealt with by Dr. Martin. The account should prove of great interest to scientific horticulturists.

**Taste and Chemical Constitution.** *Science Progress*, 29, No. 114, has an interesting article by Mr. A. J. Mee on "Taste and Chemical Constitution", in which he summarises the theories dependent upon the hypothesis that "taste must be a chemical sense, and must be conditioned . . . by chemical constitution". Physiologically, he points out, the sense of taste is similar to that of sight, but with less capacity for discriminating intensities, subject to large individual differences, and more easily fatigued than most of the other senses. There are five general classes of taste, namely sweet, bitter, salt, sour, and insipid. Acids taste sour, but vary considerably in the strength of solution in which they retain that taste. Taste has been attributed in the past to hydrogen ion concentration, but no quantitative relationship has been proved, and it is generally assumed that it is the combination of the anion and cation that determines the taste of a substance. The mixing of tastes is still not understood, but research has shown that sweet and bitter substances are often closely related chemically. Mr. Mee discusses the chemical possibilities in some detail. The chief difficulty lies in discovering the relationship between the arrangement of the groups in the molecule of the substance and its taste. The personal element, he declares, must be eliminated before the way is clear for research into the subject.

# Chromosome Behaviour in Terms of Protein Pattern

By DR. D. M. WRINCH, Girton College, Cambridge, and Mathematical Institute, Oxford

CHROMOSOMES are molecular aggregates. An ultimate objective, both of cytology and of genetics, must therefore be to interpret their findings in terms of the molecular structure of chromosomes. If, as there seems reason to suppose, chromosomes consist substantially of aggregates of protein molecules in association with nucleic acid, the properties of such aggregates must inevitably determine the behaviour of chromosomes in general, the characteristics of individual chromosomes being attributable to the possession of individual protein patterns.

In view of recent advances in our knowledge of proteins[1], it is reasonable that an attempt should now be made to see how far the properties of chromosomes and the facts of genetics may be brought into relation with certain known facts of protein structure.

To this end a molecular model—however inadequate—must be constructed. The model consists of one or more two-dimensional sheets in the form of a long, worm-like, uni- or multi-molecular surface. The units which lie disposed, possibly helically, along the surface are homologous protein molecules of the classical type[2]—peptide linked amino acids—

. . . -NH-CO-CP-NH-CO-CQ-NH-CO-CR-NH- . . .

put end to end. In consequence, the specification of a chromosome will be in terms of the side chains . . . *P Q R* . . . belonging to molecules consisting of certain numbers of amino acid residues, and, in the most general case of $n$ molecules, will consist of a linear sequence of $n$ linear sequences

$$A_1B_1C_1 \ldots X_1Y_1Z_1A_2B_2C_2 \ldots X_nY_nZ_n.$$

Such an arrangement is in excellent accord with the structure recently proposed for clupein[3], the basic protein of herring sperm, since this structure is specified in terms of a sequence of side chains, namely,

. . . . *M A A M A A M A A* . . . .

with, in some cases,

. . . . *M A A A A M A A M A A A A*;

where *A* represents arginine and *M* some monoimino or monoamino-monocarboxylic acid. The specificity of a given chromosome may be regarded as an expression of its particular protein pattern. (The orderly arrangement of black and white notes on the keyboard of a piano provides a rough picture of what is meant.) Since arginine is known to be the major constituent in sperm of various species, an attractive hypothesis (as a first approximation) is to define chromosomes in such species as various sequences of *M* and *A*. Even if we maintain the ratio of 2 to 2·5 *A* molecules to one *M* molecule, as required by the chemical analysis of clupein, a considerable and presumably sufficient variety of sequences is available.

The end groups of the arginine side chains in the protein molecules[4] are completely ionised for $p\mathrm{H} < 9$ and the four acidic groups in the molecules of nucleic acid[5] for $p\mathrm{H} > 4$, and salt compounds will be formed. In the range $p\mathrm{H}$ 4 to $p\mathrm{H}7$, nucleic acid has a variable *zwitterionisch* character, consequent upon the ionisation of the fifth acidic group ($p\mathrm{K} = 6{\cdot}0$) and of the amino groups in cytosine ($p\mathrm{K} = 4{\cdot}2$), in adenine ($p\mathrm{K} = 3{\cdot}7$), and in guanosine ($p\mathrm{K} = 2{\cdot}3$). The degree of ionisation of the end carboxyl and amino groups of the individual polypeptide chains (which in clupein are on the average 28 residues = 98 A. long[3]) is also variable in this range.

Cyclical changes in $p\mathrm{H}$ in this range are believed to occur during mitosis[6]: they would entail a cyclical variation in the degree of hydration of the molecular aggregate as a whole, which accords well with the swollen state of the chromosomes in early prophase[7,8], and with the severely dehydrated state of chromosomes at metaphase established by Belar in a classical experiment[9]. By analogy with keratin[10], the molecular aggregate may be regarded as being endowed with considerable powers of contraction, due to a number of different contractile factors. A cyclical change in $p\mathrm{H}$ suggests another technique of contraction, which in view of the facts of differential condensation (heteropycnosis)[11,12] is possibly the most important: for the change entails cyclical readjustments in the association of the protein chains with molecules present in the cytoplasm, in particular in the association with the molecules of nucleic acid. The *zwitterionisch* character[11] of molecules appears to provide a key to many cytological problems, notably to those concerned with the geometry[14] and dynamics[9,15] of chromosomes, which have recently been the subject of a number of cytological studies.

The model may also be studied in relation to the other essential properties of chromosome, namely, growth and division. The chromosome here pictured as a cylindrical mosaic or manifold—but with a radius running into thousands of angstroms—may add to its material by the wrapping round of new sheets, each new sheet being laid down over the old mosaic, as in the case of keratin[16]. Alternatively—and more probably—it may grow after the manner of a smectic crystal, such as a film of sodium oleate, where growth consists in other molecules slipping into their places and increasing the area[16]. The incorporation of sufficient new material would then lead to instability, the tendency to division being aggravated by a change in $p\mathrm{H}$ which gives the whole aggregate a larger net charge—and the molecular aggregate (now a charged shell) divides after the manner of a charged drop.

Our model is also of significance for genetics. Two chromosomes defined respectively by :—

$$A_1B_1C_1 \ldots X_1Y_1Z_1A_2B_2C_2 \ldots X_nY_nZ_n$$

$$A'_1B'_1C'_1 \ldots X'_1Y'_1Z'_1A'_2B'_2C'_2 \ldots X'_nY'_nZ'_n$$

will differ genetically if they differ in one or more members of their sequences. Genetics formally requires of a chromosome that it be specifiable as a sequence $a\ b\ c\ d \ldots x\ y\ z$ which is capable of certain types of behaviour, for example, fusion and fragmentation, represented respectively by :—

$$abcd \ldots p + qrstu \ldots xyz \rightleftharpoons abcd \ldots\ldots pqrstu \ldots\ldots xyz.$$

For the units $a\ b\ c$ an upper limit of 200–300 A. has been suggested by H. J. Muller and A. A. Prokofyeva[17]. We therefore identify a genetic character with a sequence of $n$ residues: since the length of an amino acid residue[18] is 3·5 A., the upper limit would allow $n$ to be anything up to 86. With this identification,

the phenomena of fusion and fragmentation fall neatly into place on the basis of the classical researches of Fischer, which would translate them into the form :—

. . . -CO-CP-$NH_2$ + COOH-CQ-NH- . . . ⇌
. . . -CO-CP-NH-CO-CQ-NH- . . . + $H_2O$.

A detailed investigation will be published shortly, offering molecular interpretations of a number of genetic and cytological facts, including those relating to the nature of chromocentres, heterochromatin and euchromatin[19], the behaviour of the spindle attachment[8], the nature of chromomeres and of some of the forces between chromosomes[6]. The fundamental approach to the problem is clearly the study of the molecular structure of chromosomes by X-rays. Pending the necessary technical developments we must pursue our inquiries inductively. The central theme of the work—the chromosome as a crystal structure—gives unity and coherence to the task, the considerable body of knowledge of protein molecules in general, including those of globular type[20], providing a most admirable guide.

Happily, opportunities of testing the hypothesis are not wanting, those rendered possible by the new work on clupein[3] being specially attractive.

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## Brood Diseases of Bees

THE eighteenth of the Rothamsted conferences was held at the Experimental Station on May 19, 1934, under the chairmanship of Sir John Russell, and was devoted to papers and discussions on the brood diseases of the hive bee. Its proceedings have now been published under the title of "Brood Diseases of Bees".*

Notwithstanding the extensive researches which have been conducted on foul brood diseases of bees, the present knowledge of the subject is still very incomplete. Practically no scientific work has been done in Great Britain on brood diseases since 1885, and such information that is at present available is derived chiefly from the results of investigations carried out in other countries. The advisability of studying this subject in England has been recognised for some years by the Rothamsted authorities, and the advisory committee connected with the apicultural branch of the Experimental Station strongly urged that action should be taken.

Sir John Russell, in his introduction to the published report on the Conference, explains how the means for carrying out the necessary work was obtained. A decisive move was made by the British Bee Keepers' Association, which secured from its constituent bodies subscriptions enabling it to guarantee a sum of £250 a year for three years. An equivalent amount has been voted by the Agricultural Research Council, and a capital sum of £250, for the special equipment needed, has been obtained through the generosity of private benefactors. Dr. J. C. G. Ledingham, and the managers of the Lister Institute, have offered the use of their laboratories for any special bacteriological work required. The actual investigations started in the present year when Dr. H. L. A. Tarr was appointed in charge of the work. The Conference, it may be added, was called at the outset of the investigations in order to review the whole subject.

In the printed report, Mr. D. Morland contributes an article on the distribution of foul brood diseases in England, which is based on replies received in response to a questionnaire. The information received indicates the need for a full survey of the incidence, varieties and means of control of brood diseases, rather than any feeling that the data obtained is at all complete or that informants were always correct in their diagnoses. Other contributors discuss the historical aspect of our knowledge of brood diseases and the subject of legislation with reference to bee diseases in other countries. The possible benefit to be derived from legislation, as a means of controlling the spread of brood diseases, suggests itself when the success attendant upon such methods in Switzerland, for example, be taken into account. In reviewing the present position of the scientific study of foul brood diseases, Dr. Tarr lays stress upon the confusion that at present exists as regards this subject. American foul brood, European foul brood, sacbrood and rarer infections are individually discussed. The concluding article by Mr. D. Morland is essentially practical and summarises our knowledge with regard to the symptoms, means of prevention and current methods of treatment of the various diseases in question.

The papers contained in this report provide an excellent summary of the present status of the whole subject: they indicate what is already known and

* Rothamsted Conferences, 18: Brood Diseases of Bees. (Secretary, Rothamsted Experimental Station, Harpenden, Herts.) 1*s.* 6*d.*

where research is most needed. Whereas most investigators agree in ascribing American foul brood to *Bacillus larvæ*, the etiology of European foul brood remains much in doubt, and the problem is further complicated by the presence of 'secondary invaders' which have often been confused with the primary agent responsible for the disease. Whether this primary agent is *Bacillus pluton*, as it is generally regarded to be outside Britain, needs much investigation, and the work is hampered by the fact that there are evident difficulties attending its culture. With advance of bacteriological knowledge of the diseases in question, improved methods of diagnosis and treatment may be expected to result, and the work now being undertaken at Rothamsted is directed towards the solution of these problems. A. D. I.

## Sleep and Hypnosis

IN an address on sleep and hypnosis delivered at a meeting of Section J (Psychology) of the British Association at Aberdeen, Dr. William Brown pointed out that although there are marked contrasts between hypnosis and sleep, there is also a close connexion. The muscles in sleep are in a state of relaxation, and in hypnosis in a state of rigidity. In sleep the knee-jerks become less pronounced and eventually disappear: in the hypnotic state, however deep, they remain undiminished. There are other differences; for example, in sleep the subject is unable to respond to a suggestion to perform a simple act, whereas even in deep hypnosis such obedience is readily forthcoming. But in spite of these contrasts, Dr. Brown holds that there is a close connexion between the two states. Sleep can be induced by hypnotic suggestion even to the cure of some forms of insomnia, and the hypnotic state itself readily passes into a state of sleep. Sleep-walking is a spontaneously occurring phenomenon closely analogous to what is induced in a good hypnotic subject. A person who frequently walks in his sleep is, as a rule, exceptionally easy to hypnotise, and in the hypnotic state the dreams of the somnambulist may be recalled and the abnormal condition often rectified.

In inducing hypnosis, if the subject is instructed to relax and breathe deeply and regularly, the result is a close approximation to normal sleep, although the total state remains one of hypnosis, the knee-jerks being present, and the power to apprehend and react to the suggestions of the hypnotist continuing. In such a mild hypnoidal condition, the subject is unconscious of the outside world, but acutely aware of the hypnotist, and able to concentrate intensely upon certain suggested ideas. In this way, avoiding the unnecessary phenomenon of catalepsy, access may be obtained to some of the deeper levels of nerve function, and therapeutic adjustments can be made.

On the neurological side, the relationship between sleep and hypnosis is probably most accurately given by the theory of I. P. Pavlov, according to which both states involve internal inhibition in the cerebral cortex, spreading to the subcortical centres in the case of the former, and limited to the cortex in the case of the latter.

Mr. R. J. Bartlett reported on association tests with psychotic patients. In free association, complex indicators are progressively exaggerated with increasing mental disability, while, with controlled association, the difference from normality varies considerably, being greatest with opposites. Small but significant correlations were obtained between physicians' estimates and test scores, and there are indications that the work may prove of practical value in securing, for the physician, additional contact with the patient's mental troubles, and, for the patient, renewed contact with his own rational past.

## Mechanisms of Cellular Respiration

IN his Croonian Lecture on the "Mechanisms of Cellular Respiration" delivered to the Royal Society on December 13, Prof. D. Keilin, Quick professor of biology and director of the Molteno Institute in the University of Cambridge, described in some detail the part played by cytochrome in the respiratory process. He said that cellular respiration consists essentially of the activation of metabolites by dehydrogenases and their coferments: the activated molecules are then oxidised by reacting with a suitable hydrogen acceptor, such as molecular oxygen, cytochrome, Warburg's yellow enzyme, oxidised glutathione, methylene blue or hydrogen peroxide. Of these, cytochrome, the yellow enzyme and glutathione can be re-oxidised by oxygen, thus acting as respiratory catalysts.

The most widely distributed respiratory system in aerobic cells is composed of dehydrogenase-substrate-cytochrome-oxidase-oxygen. Cytochrome is a mixture of three hæmochromogen compounds, with distinct absorption bands. Its reduction is inhibited by removal of metabolites or addition of narcotics: its oxidation is inhibited by poisons like potassium cyanide, hydrogen sulphide or carbon monoxide.

Haas, working in Warburg's laboratory, has recently arrived at the conclusion that the total respiration of starved yeast cells proceeds through cytochrome, as the result of experiments in which he estimated their cytochrome content, oxygen uptake and time of reduction of oxidised cytochrome after addition of potassium cyanide. The yellow enzyme of Warburg is composed of an active pigment group combined with a protein: it acts as a carrier between the activated metabolites and molecular oxygen. The leucoform is easily oxidised by methylene blue and oxygen and requires one molecule of oxygen per molecule of pigment: in the cells of baker's yeast, under aerobic conditions, it is responsible for only 0·5 per cent of the total oxygen uptake.

Certain dehydrogenases, such as xanthine oxidase and uricase, can react directly with oxygen, independently of carriers: both these enzymes are inhibited by potassium cyanide, but not by hydrogen sulphide or carbon monoxide, and both activate their metabolites; in both systems molecular oxygen is reduced to hydrogen peroxide, which can bring about secondary or coupled oxidations. In the cells of certain bacteria, oxidations can take place anaerobically by reactions between two dehydrogenase systems, one metabolite acting as hydrogen donator and the other as hydrogen acceptor: for example, lactate is oxidised to pyruvate while fumarate is reduced to succinate.

## University and Educational Intelligence

BRISTOL.—Dr. MacGregor Skene has been appointed Melville Wills professor of botany in succession to the late Prof. O. V. Darbishire. Dr. Skene, who is a graduate of Aberdeen, went to Bristol as senior lecturer in botany in 1926, and was made reader in that subject in 1929.

EDINBURGH.—At a graduation ceremony on December 14, the degree of D.Sc. was conferred on Mowbray Ritchie for a thesis on reaction kinetics of photochemical and related systems, and on Alexander M. Smith for a thesis on variation in soil acidity, the protein content of oats and the *Aspergillus* method of soil analysis. The degree of Ph.D. was conferred on Alan Mozley (thesis—"The Fresh-Water and Terrestrial Mollusca of Northern Asia"), Margaret F. Ritchie (thesis—"Optical Rotatory Power of Organic Acids and their Derivatives"), George P. Sillitto (thesis—"Comparative Reactivities of Chlorine Atoms on Chlorobenzene"), R. P. Sinha (thesis—"Adsorption of Gases and Water by Coal"), and James S. A. Spreull (thesis—"Microscopic Structure of the Spleen of Domestic Animals").

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THE annual meeting of the Mathematical Association will be held at the Institute of Education, London, W.C.1, on January 7–8, when Mr. A. W. Siddons will take the presidency for the year 1935, in succession to Prof. E. H. Neville. The subject of the presidential address will be "The Food of the Gods". The following have been nominated for election as honorary members: Prof. E. Borel, University of Paris; Prof. J. Hadamard, University of Paris; Prof. G. H. Hardy, University of Cambridge; Prof. D. E. Smith, Columbia University; Prof. E. T. Whittaker, University of Edinburgh. Further information can be obtained from C. Pendlebury, 39 Burlington Road, Chiswick, London, W.4.

THE small independent college in America, with its ideal of a 'liberal education', has no longer the unrivalled prestige it enjoyed for generations, but it still counts among the notable formative influences moulding the youth of that country. In *School and Society* of October 20 appear two addresses delivered at the installation of the twelfth president of one of those institutions—Union College, Schenectady, New York. The new president, after enlarging on the unique value of the small college and the dangers that threaten it, suggested that American Governments might well go further along the line of the British Government in providing competitive college scholarships. "If the state," he said, "is to dry up the old wells of philanthropy by confiscatory taxation—and at the present moment this might seem to some no mere hysterical fear—it might support the training of its leaders in just this way, through the subsidy of selected brains". The other address, by Dr. Nicholas Murray Butler, entitled "The Challenge to Education" aimed at rallying the forces of light and leading at a time when there is imminent danger of the submergence of much of the best of the nation's social heritage in a tide of blatant scepticism and disunion, part of the aftermath of the War. The best hope for the future is, he thinks, in the endowment with a liberal education of as many as possible of those who are capable of attaining to it.

## Science News a Century Ago

### Aurora Borealis seen at Woolwich

On December 23, 1834, William Sturgeon sent to the editors of the *Philosophical Magazine* an account of an aurora he had seen the previous evening. "A beautiful Aurora Borealis," he said, "was seen from this place last night. I was on Woolwich Common when I first saw it, then exactly six o'clock. It consisted of several groups of vertical beams of pale yellowish light on both sides of the north star, extending nearly to equal distances in the western and eastern directions. These beams presented the strongest light at their bases, and grew gradually fainter, to their superior extremities, here they softened and gently glided into the most attenuated light and were lost at various altitudes some of which were near to the zenith. . . . During the display of the fine streamers which first presented themselves about five minutes past six I hurried home to adjust a magnetic needle. It was about half past six before I had my magnetic apparatus fit for observation and the splendour of the aurora had now passed its meridian. I diligently watched the needle and the aurora until half past ten, but observed nothing in the motions of the former that could possibly be attributed to the influence of the latter."

### Death of Malthus, December 29, 1834

The Rev. Thomas R. Malthus, the well-known writer on population problems, died at Bath on December 29, 1834. He was born on February 14, 1766, at the Rookery, near Dorking, then the property and home of his father. Educated privately in the first instance, Malthus entered Jesus College, Cambridge, in 1785, graduating ninth wrangler, and becoming in 1797 a fellow of his College. He was ordained in the Church of England, and for a time held a small living in Surrey. In 1805 Malthus was appointed professor of history and political economy at Haileybury College, Hertfordshire, the training centre for cadets of the East India Company. Here, throughout his life, he was able to pursue his researches upon the economic structure and implications of social life. Malthus joined the Statistical Society on its foundation in 1834; already, in 1819, he had been elected a fellow of the Royal Society, and, in that year, signed the charter book. In 1798 Malthus published his views in a work entitled, "An Essay on the Principle of Population as it affects the future Improvement of Society, with remarks on the Speculations of Mr. Godwin, M. Condorcet, and other Writers". Revised and enlarged editions of the treatise were the subject of his facile pen down to 1826. A passage that Darwin wrote in his autobiography ("Life") may be recalled here: "In October 1838 I happened to read for amusement 'Malthus on Population', and being well prepared to appreciate the struggle for existence which everywhere goes on from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances favourable variations would tend to be preserved, and unfavourable ones to be destroyed. The result of this would be the formation of new species." Notwithstanding that much censure and calumny followed his published opinions, Malthus uniformly maintained composure and toleration, traits which were inherent in his character.

## Societies and Academies

### DUBLIN

**Royal Irish Academy.** J. J. NOLAN: A method for counting atmospheric ions and determining their mobility. A simple method is described by which accurate counts of atmospheric small ions may be made.

### PARIS

**Academy of Sciences,** November 19 (*C.R.*, **199**, 1077–1164). MARIN MOLLIARD and ALBERT CRÉPIN: The characters presented by green plants which develop in air enriched with carbon dioxide. A description, with reproductions of photographs, of the effects of atmospheres containing 0·5, 2 and 10 per cent of carbon dioxide on the radish. MAURICE GIGNOUX and LÉON MORET: The stratigraphy of the external edge of the Flysch zone of the Embrunais, between the Durance and the Drac (Piolit and Autanes massifs, Hautes-Alpes). E. MATHIAS: The idea of impurity in naked globular lightning. HANS SCHWERDTFEGER: Remarks on matrices with linear forms. D. PEREPELKINE: The directions of curvature of a $Vm$ in $Rn$. M. HAIMOVICI: Some types of Finsler metrics. P. VINCENSINI: Deformable cyclic systems. ALBERT TOUSSAINT: Contribution to the study of the ground interaction for supporting wings. ROGER DUCHÈNE and JULES VERDIER: Forces resulting from knocking in (internal combustion) motors. Studies on the bouncing pin knockmeter. GEORGES DURAND: The application of the mass-luminosity relation to the calculation of the orbital elements of the spectroscopic double stars. NY TSI-ZE and TSIEN LING-CHAO: The laws of the disengagement of electricity by torsion in quartz crystals. CH. FABRY: Remarks on the preceding communication. Reference to the work of E. P. Tawil on the same subject. EDMOND ROUELLE: The transitory regimes produced on closing an oscillating circuit with an iron nucleus. G. KRAVTZOFF: The cathodic behaviour of the organic salts of copper. Study of the different factors. RENÉ LUCAS: The phenomena of optical mirage due to elastic waves. RENE FREYMANN and ARTHUR STIEBER: The effect of temperature and of visible and infra-red radiations on the electrical resistance of boron. The results of Weinstraub on the rapid variation of the electrical resistance of boron with temperature are confirmed. The changes in the resistance of boron when exposed to infra-red rays can be utilised for detecting radiation between 0·5$\mu$ and 0·85$\mu$. GEORGES DÉJARDIN and MLLE. R. SCHWÉGLER: The luminescence excited by rolling mercury in a glass bulb containing impure neon under low pressure. Study of spectrograms obtained with this light source shows that, excluding known mercury lines, the spectrum is very similar to that of the aurora. Nearly all the lines can be attributed to either the atom or molecule of nitrogen. FRÉDÉRIC DIÉNERT and FERNAND VILLEMAINE: Contribution to the study of photo-chemical reactions. The action of phosphorous and hypophosphorous acids on uranyl salts. Uranyl salts are precipitated from acid solutions by sodium hypophosphite in sunlight: there is no apparent reaction in the dark. EDOUARD RENCKER: The dilatometric study of some ternary (soda, silica, alumina) glasses. FRANÇOIS CANAC: Study of the topography of certain surfaces from their coefficient of light diffusion. Application to the study of corrosion. WILFRIED HELLER and MICHAEL POLANYI: Quantitative studies of the reactions of atoms. IVAN PEYCHÈS: The Raman spectrum of tartaric acid and of tartrates in solution in water. Diagrams of the Raman spectra of tartaric acid, ethyl tartrate and six alkaline tartrates are reproduced, and the data briefly discussed. EUGÈNE DARMOIS and YEU KI HENG: The measurement of the strength of acids. A method is suggested based on the change in the rotatory power of solutions of ammonium tetramolybdate produced by the addition of acid. By this method, perchloric acid is stronger than benzenesulphonic acid. MME. SIMONNE ALLARD: The magnetic properties of a free radical, xanthyl-$\alpha$-naphthylmethyl. From the measurement of the magnetic susceptibilities of solutions of dixanthyl-dinaphthylethane, it is deduced that 78–94 per cent is dissociated into the free radicle. This result is in agreement with the cryoscopic measurements of Gomberg. LÉON PIAUX: The Raman spectrum of some derivatives of cyclopentene. The synthesis of $\Delta$.1-benzylcyclopentene. MLLE. BLANCHE GREDY: 3-cyclopentyl-1-propyne and some of its derivatives. Six new compounds are described with details of their Raman spectra. GEORGES DARZENS and ANDRÉ LÉVY: A new general method for the synthesis of tetrahydronaphthalenic acids and of naphthalene hydrocarbons. C. STANFIELD HITCHEN and RENÉ VAN AUBEL: The composition and age of crystalline uraninite from Katanga. From the results of spectrum analysis, it is concluded that this uraninite is a primary hydrothermal mineral. The lead–uranium ratio is 0·0863. PAUL FALLOT, LÉON MORET and EDOUARD ROCH: The Lias series of the Skoura country (Haut-Atlas marocain). JACQUES FROMAGET: The Trias in the Haut-Laos synclinal. JOSEPH BLAYAC and RODOLPHE BÖHM: A notable extension of the Ordovician in the eastern part of the Montagne Noire. MARCEL SOLIGNAC: Geological and hydrological results of No. 3 boring at Ben Gardane (Extrême-Sud-Tunisien). J. COULOMB and G. GRENET: The theory of seismographs with electromagnetic magnification. MLLE. MADELEINE FRIANT: The primitive type of the upper molars in rodents. KENNETH SMITH and JEAN DUFRENOY: The *Y*-virus of the Solanaceæ. The *Y*-virus tends to slow down the synthesis of the complexes forming the cytoplasm and hence to cause the accumulation of amino-acids. A. JUILLET and R. ZITTI: The seasonal variations of hydrocyanic acid in *Molinia cærulea*. AUG. CHEVALIER: Preliminary sketch of the vegetation of the Cape Verde islands. J. BOUGET: The culture of potatoes from seed at Bagnères-de-Bigorre (560 metres). G. LEMÉE: The beech association in the Perche and the north-west of France. PHILIPPE JOYET-LAVERGNE: A new theory on the mechanism of intracellular oxido-reductions. E. GRYNFELTT: The modifications of the chondriome of the cells of the Flexner-Jobling tumour of albino rats in the course of their evolution.

### CAPE TOWN

**Royal Society of South Africa,** October 17. F. R. C. REED: A new lamellibranch from the upper Dwyka beds of South-West Africa. S. HONIKMAN, H. A. SHAPIRO and H. ZWARENSTEIN: Variations in the ovarian response of *Xenopus* to the gonadokinetic principle of the anterior pituitary (1). Anterior pituitary extract assayed on frogs in July gave 263 units per gm. original tissue. A similar assay in October gave 77 units per gm. In July the ovary–body weight ratio was 110, in October, 80. The potencies of extracts from different batches of anterior

pituitaries prepared at the same time and assayed on animals from the same stock varies considerably. It would be premature to conclude that the correlation between the ovary – body weight and the number of units per gm. observed above is a true correlation.

### LENINGRAD

**Academy of Sciences** (*C.R.*, 3, No. 5). I. P. NATANSON: Note on the convergence of singular integrals. G. FICHTENHOLZ and L. KANTOROVICH: Some theorems on linear functionals. P. RACHEVSKIJ: The infinitesimal structure of the geodesic lines in two dimensions, considered with the approximation of the fourth order. G. GUREVITCH: (1) Some arithmetical invariants of a trivector and of a cubical shape. (2) Reduction of a trivector to a canonical form in a special case. E. BRUMBERG and S. VAVILOV: Statistical structure of the field of interference. A. ANSELM: Contribution to the theory of the surface ionisation of heated metals. N. FUCHS: Activation energy by evaporation and condensation. A. SOKOLSKIJ: Absolute method of determining the coefficients of viscosity in liquids. N. KALITIN: Diurnal and annual period of the long-wave solar radiation in the infra-red radiation is less than that in the case of total radiation, because of the effect of water vapour in the atmosphere. B. TARUSOV: Dielectric constant of muscle. The high value of the dielectric constant in a living muscle is probably connected with the presence of free salts, and changes with variations in their quantity. M. K. GRODZOVSKIJ and Z. TCHUCHANOV: Gasification of solid fuel. N. TAGEJEVA, S. ZEITLIN and A. MOROSOVA: Boron content of natural waters. Boron is a characteristic component of oil-well waters, probably connected with their geochemical history. J. TOLMACHEV and A. FILIPPOV: Presence of Rb, Be, Ga and Sr in nephelines. V. CHLOPIN: Geochemistry of helium. N. GORNOSTAEV: Geochemistry and tectonics of the gold quartz veins of the Soviet mine in the North Yenisseisky taiga. P. ZHIVAGO, B. MOROZOV and A. IVANITSKAJA: Influence of hypotony on cell division in the tissue cultures of embryonic heart. A. CHARIT and N. CHAUŠTOV: Flavines and their determination in animal tissues. L. VARDANIANZ: Upper Jurassic orogenetic phases of the Caucasus. A. NIKIFOROVA: Contribution to the stratigraphy of the Upper Palæozoic of the north-eastern outskirts of the Great Donetz basin. A. TARANEC: A short review of the fishes of the genus *Gymnogobius*, with a description of one new species and notes on some related genera.

### ROME

**Royal National Academy of the Lincei**: Communications received during the vacation. B. MANIÀ: The differential equations dependent on a curve. M. VILLA: The theory of hyper-algebraic hyper-surfaces. L. TOSCANO: The integration of recurrent successions of the second order, linear and homogeneous (2). C. SEVERINI: The double series of orthogonal and normal functions (2). A. ROSENBLATT: The equations to the partial derivatives of the parabolic type with two independent variables. L. PINCHERLE: The natural width of X-ray lines. An attempt is made to obtain theoretical justification for the results of recent measurements of the width of X-ray spectral lines on the basis of quantum mechanics. It is found that the natural width of the lines, taking account only of the probability of passage with emission of light, is in accord with the experimental data only for transitions of deep electrons of very heavy elements. In other cases, quantum jumps without radiation (Auger effect) must be taken into consideration; the influence of these suffices to explain satisfactorily the experimental data. U. FANO: The calculation of optical terms, in particular the ionisation potentials of bivalent metals, by means of Fermi's statistical potential. G. RACAH: The so-called electric moment of the electron. G. SCAGLIARINI and F. MONFORTE: The reaction between sodium nitritopentacyanide and alkali sulphides (4). The final product of the interaction of sodium nitropentacyanide and excess of potassium sulphide is an alkali sulphonitroprusside. E. PARISI and G. DE VITO: Contribution to the knowledge of the maturation of cheese. (1) Proteases, diketopiperazine and proline peptides. Ripe cheeses are found to contain compounds resistant to proteases, such as proline peptides and diketopiperazine, which have not hitherto been observed in cheese. The conclusion is drawn that the extent to which the casein of cheese undergoes degradation is closely related to the proportion of proline products present. GISELDA SERRA: Observations on the masticatory apparatus of the genus *Orthopsis*. G. MONTALENTI: Experimental parthenogenesis of the egg of the lamprey. C. GUARESCHI: Processes of regeneration and their limits in experiments on the centrifugation of the insect chrysalis. Centrifugal force acts on insect chrysalides as a disturbance of the metamorphic processes, tending to arrest or retard these according to the intensity and duration of the force applied and to the constitutional resistance of the individual. GIUSEPPINA DRAGONE-TESTI: Action of certain salts on the germination of embryos of grain outside the seeds. When added to Knop's solution, on which grain embryos are grown, various salts, particularly borax and zinc sulphate, exert a stimulating effect on the growth of the seedlings.

### SYDNEY

**Royal Society of New South Wales**, October 3. A. H. VOISEY: The physiography of the middle north coast district of New South Wales. The main features are: (1) the dissected New England highlands, (2) an intermediate area of broad valleys in which the streams are entrenched, (3) coastal plains of accumulation with inliers of older rock, and (4) a coast-line of long curving beaches between rocky headlands. The coastal plain is particularly wide around the Macleay River, where the rocks eroded have been soft sandstones and tuffs. Submergence to the extent of at least 70 ft. is proved, and a small emergence is held to be responsible for rock-platforms, raised beaches, land-tied islands and other phenomena. There is strong evidence that this emergence has occurred during the period of human occupation. G. J. BURROWS: Some hydroxy salts of secondary and tertiary arsines. Although tertiary arsines are oxidised to arsine oxides or dihydroxy arsines when treated with permanganate or hydrogen peroxide, the mechanism of oxidation by moist atmospheric oxygen appears to be different. Thus a specimen of phenyl dimethyl arsine, on prolonged exposure to the air, was partly converted to phenyl methyl arsinic acid. Arsine oxides and arsinic acids combine with mineral acids to give stable crystalline salts with characteristic melting points. L. W. O. MARTIN: A theory of association. There are two theories of association. The dipole theory is found to be

unsatisfactory, and not in accordance with many observed facts. A development of Sidgwick's theory of chemical association is made, and a rule deduced giving conditions for such association. When two atoms of the same element can have a normal covalent and a co-ordinate electron pair bond with the same atom, and if quantum numbers $n$ and $l$ are the same for both electron pairs, association follows, the association being stabilised by quantum mechanical resonance under certain conditions. HF, $H_2O$, HCl, ketones, oximes, carboxylic acids, esters, etc., are shown to fit in with the theory. A. R. PENFOLD, G. R. RAMAGE and J. L. SIMONSEN: The essential oil of *Calythrix tetragona*, var. 'A'. The leaves and terminal branchlets yield 0·7–1 per cent of an essential oil, the principal constituents of which are *d*-*a*-pinene, *d*-citronellol, *d*-citronellyl formate and the methyl esters of geranic and probably citronellic acids, the ester fraction comprising 60–70 per cent. This is the first natural occurrence of geranic acid which has been recorded.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, **20**, 539–564, Oct. 15). R. H. SCIOBERETI: On the determination of the geocentric distance in the Laplace-Leuschner direct method for parabolic orbits. H. K. BENSON and A. M. PARTANSKY: The rate and extent of anaerobic decomposition of sulphite waste liquor by bacteria of sea-water mud. Liquor from a works manufacturing paper pulp by the acid sulphite process was used. Temperature of incubation and dilution of liquor governed rate of fermentation but did not affect extent of decomposition. 85 per cent of the reducing sugars was destroyed. The reduction products, methane and hydrogen sulphide, were preferentially formed while sulphide was available; the oxidation product was carbon dioxide. It is stated that the evolved gases, based on the yield with fermentation at 36° C., had a heating value of 649 B.T.U. per cubic foot. J. L. WALSH: Note on the location of the critical points of harmonic functions. E. D. GOLDSMITH: Correlation in planarian regeneration. Planarians were made double-headed by longitudinal splitting. Removal of one head may then be followed by complete, retarded or no regeneration of the head. Failure of regeneration is correlated with the presence of the remaining head. Frequency of regeneration was greatest in a zone lying between levels just posterior to the eyes and anterior to the pharynx. The effectiveness of this region is possibly correlated with high formative cell number and high (SH) content. F. B. SUMNER: Does 'protective coloration' protect? Results of some experiments with fishes and birds. Numbers of mosquito-fish (*Gambusia patruelis*) were placed in two cement tanks, one painted white, the other black. After seven or eight weeks, equal numbers of black-adapted and white-adapted fish were removed and placed in a whitish coloured tank and two Galapagos penguins were released in the tank to hunt and eat them. A similar experiment was tried in a black tank, and the interval between release of fish and birds was varied. Of the fish consumed in the whitish tank, 61 per cent were 'blacks', 38 per cent were 'whites' and 1 per cent unidentifiable; of those consumed in the black tank, 27 per cent were 'blacks' and 73 per cent were 'whites'. Hence fish that harmonise in shade with their immediate surroundings are less likely to be eaten by certain birds; coloration here has a definite survival value.

## Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

**Sunday, December 23**

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Dr. Isabella Gordon: "Crustacea of the Deep Sea".*

**Thursday, December 27**

ROYAL INSTITUTION, at 3.—Prof. W. L. Bragg: "Electricity" (Christmas Juvenile Lectures. Succeeding lectures on December 29, January 1, 3, 5 and 8).

## Official Publications Received

GREAT BRITAIN AND IRELAND

The National Smoke Abatement Society. Fifth Annual Report, 1934–5. Pp. 28. The Smokeless Home. Pp. 12. (Manchester: National Smoke Abatement Society.)

The National Institute of Industrial Psychology. Report 5: An Account of the Research Work carried out by the National Institute of Industrial Psychology during the Years 1921–34. Pp. 37. (London: National Institute of Industrial Psychology.) 2*s.* 6*d.*

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1603 (Ae. Tech. 805): Lift and Drag of a Wing Spanning a Free Jet. By H. Glauert. Pp. 8+1 plate. 6*d.* net. No. 1611 (A. 142b): The E.M.F. between Metals in Seawater. By J. W. Willstrop. Pp. 10+1 plate. 9*d.* net. No. 1614 (T. 3404): Abstract—Statistical Measurements of Turbulence in the Flow of Air through a Pipe. By Dr. H. C. H. Townend. Pp. 2. 2*d.* net. No. 1616 (Strut. 182): Buckling of a Linked Beam having a Strength in Flexure and Shear. By R. A. Fairthorne. Pp. 6+1 plate. 6*d.* net. (London: H.M. Stationery Office.)

P E P (Political and Economic Planning): Industries Group. Housing England: a Guide to Housing Problems and the Building Industry, presented in a Report by the Industries Group of P E P (Political and Economic Planning). Pp. 158. (London: P E P.) 5*s.*

Department of Scientific and Industrial Research. Report of the Water Pollution Research Board for the Year ended 30th June 1934; with Report of the Director of Water Pollution Research. Pp. iii+44. (London: H.M. Stationery Office.) 9*d.* net.

OTHER COUNTRIES

Report on the Administration of the Meteorological Department of the Government of India in 1933–34. Pp. ii+37+2 plates. (Delhi: Manager of Publications.) 1 rupee; 1*s.* 9*d.*

U.S. Department of the Interior: Geological Survey. Bulletin 857-C: The Curry District, Alaska. By Ralph Tuck. (Mineral Resources of Alaska, 1932.) Pp. ii+99–140+4 plates. 10 cents. Professional Paper 176: Geology and Ore Deposits of the Breckenridge Mining District, Colorado. By T. S. Lovering. Pp. vi+64+15 plates. 1 dollar. (Washington, D.C.: Government Printing Office.)

Advisory Department of the Imperial College of Tropical Agriculture. Research Abstract Report of the Agricultural Department, St. Lucia, 1933. Pp. 35. (St. Lucia: Government Printing Office, Castries.)

Annual Report of the Special Officer Lac Inquiry to the Government of Bihar and Orissa (with the Financial Co-operation of the Empire Marketing Board) for the Financial Year ending March 31st, 1931. Pp. 15. Annual Report of the Special Officer Lac Inquiry to the Government of Bihar and Orissa (with the Financial Co-operation of the Empire Marketing Board) for the Financial Year 1931–32. Pp. 8. (Nankum: Indian Lac Research Institute.)

Department of Agriculture: Straits Settlements and Federated Malay States. Economic Series, No. 5: Malayan Agricultural Statistics, 1933. By D. H. Grist. Pp. ix+71. 50 cents. General Series, No. 20: Reports of the Field Branch for the Year 1933. Pp. iii+259+4 plates. 50 cents. (Kuala Lumpur.)

Southern Rhodesia. Geological Survey Bulletin, No. 27: The Geology of the Country around Filabusi, Insiza District. By J. C. Ferguson. Pp. 179+21 plates. (Salisbury.) 5*s.*

U.S. Department of Agriculture. Farmers' Bulletin No. 1742: Game Laws for the Season 1934–35; a Summary of Federal, State and Provincial Statutes. By H. P. Sheldon and Frank G. Grimes. Pp. ii+38. 5 cents. Miscellaneous Publication No. 210: Status of Waterfowl in 1934. By W. B. Bell and E. A. Preble. Pp. 18. 5 cents. Technical Bulletin No. 430: The Physical and Chemical Characteristics of the Soils from the Erosion Experiment Stations, Second Report. By H. E. Middleton, C. S. Slater and H. G. Byers. Pp. 63. 10 cents. (Washington, D.C.: Government Printing Office.)

U.S. Treasury Department: Public Health Service. Effect on the Eye of the Yellow Light of the Sodium Vapor Lamp. By James E. Ives. (Reprint No. 1640 from the Public Health Reports, Vol. 49, No. 32, August 10, 1934.) Pp. 9. (Washington, D.C.: Government Printing Office.) 5 cents.

CATALOGUES, ETC.

Conchology, Entomology, Geology, Ornithology, General Zoology, etc. (Catalogue No. 229.) Pp. 20. (London: Dulau and Co., Ltd.)

Diary for 1935. Pp. 64+16+16+Diary. (Bonnybridge: John G. Stein and Co., Ltd.)

The Wild-Barfield Heat-Treatment Journal. No. 3, Vol. 1, December. Pp. 28–40+2 plates. (London: Wild-Barfield Electric Furnaces, Ltd.)

Calendar for 1935. (Newcastle-on-Tyne: C. A. Parsons and Co. Ltd.)